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Final Report

August 1975

Program Guide and Examples

Dynamic Analysis of a Flexible Spacecraft with Rotating Components

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Huntsville, Alabama 35823

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PROGRAM GUIDE & EXAMPLES

DYNAMIC ANALYSIS OF A FLEXIBLE SPACECRAFT WITH ROTATING COMPONENTS

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FOREWORD

This report, prepared by the Dynamics and Loads Section, Martin Marietta Corporation, Denver Division, under Contract NAS8-30761, presents the results of a study that developed a digital computer program for dynamic analysis of a flexible spacecraft with rotating components. The study was performed from April 1974 to August 1975 and was administered by the National Aeronautics and Space Administration, George C. Marshall Space Flight Center, Huntsville, Alabama, under the direction of Dr. John Glaese.

The report is published in three volumes:

Volume I - Analytical Developments
Volume II - Program Guide and Examples
Volume III - Program Code

CONTENTS

ABSTRACT

This document details analytical procedures and digital computer code for the dynamic analysis of a flexible spacecraft with rotating components. Two major subject areas are considered:

(1) nonlinear response in the time domain, and
(2) linear response in the frequency domain.

The spacecraft is assumed to consist of an assembly of connected rigid or flexible subassemblies. The total system is not restricted to a topological connection arrangement and may be acting under the influence of passive or active control systems and external environments.

The analytics and associated digital code provide the user with the capability to establish spacecraft system nonlinear total response for specified initial conditions, linear perturbation response about a calculated or specified nominal motion, general frequency response and graphical display, and spacecraft system stability analysis.

The document is presented in three volumes.

I. THE DYNAMO PROGRAM

This volume is intended to provide the reader with sufficient understanding of program system DYNAMO* and its capabilities so as to permit a user to employ the program as a basic tool to analyze the behavior of a wide range of dynamical problems. Specific emphasis will be on a simulation for multiply-interconnected spinning elastic bodies responding under the combined influences of external environments and either active or passive control.

A. COMMENTS

The simulation employs a state-space approach that was developed in detail in Volume I. The state-space formulation provides an attractive basis for simulation of nonlinear dynamical problems in a general sense as well as permitting linearization of the governing equations to provide an additional foundation with which to evaluate frequency domain and linearized time domain characteristics.

An attempt has been made to relieve the user from the requirement of having to communicate with the digital program via large amounts of bulk data input. Although the program has many options available, the program data stream has been organized to require only a minimal amount of basic input data for a particular simulation. The data requirements have been further consolidated in a manner that is quite definitive for the physical system being simulated. In summary, the user can quite easily relate to the particular elements of the program requirements and thus minimize setup time required to prepare data input for a given problem. In addition, a set of self-checking features has been included in an attempt to identify and check certain compatabilities that are necessary for a proper simulation of a physically realizable system.

In an overall sense, the digital program can be employed by the user to obtain

1. nonlinear time response,
2. interaction constraint forces,

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* Dynamic Analysis - Multiple Options

3. total system resonance properties,
4. frequency domain response and stability information,
5. linearized time response.

The program outputs consist of printed and plotted results depicting

1. dynamic model construction,
2. time domain response,
3. frequency domain characteristics.

The printed outputs are of a fixed form while the user controls the plotted information through the input data stream.

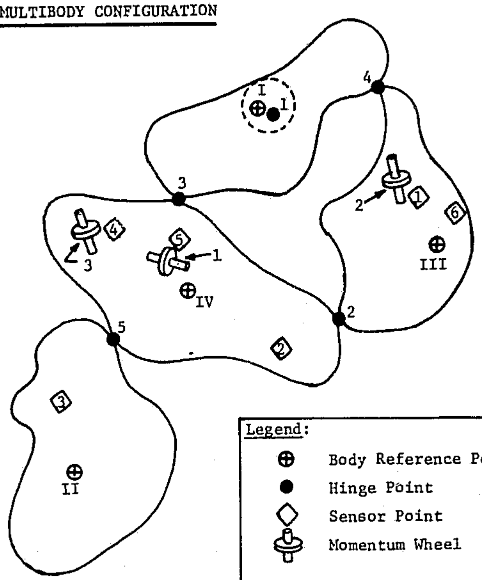
NOMENCLATURE

This discussion identifies the basic nomenclature used to synthesize a typical assembly of interconnected bodies. The theoretical development, program users' manual, and demonstration problems make extensive reference to various terminologies that are clarified here. Figure I.B-1 provides a visual display that illustrates many of the items being discussed and will be repeatedly referred to in the ensuing discussions.

The overall system "topology" is identified by the user via the input integer array ITOPOL that contains the necessary information describing which "hinges" interface which bodies. Each body contains a body reference point that is the origin of an orthogonal cartesian body axis system. This point need not coincide with the body center of mass.

Contiguous "bodies" are interfaced through a "hinge". We say <u>interfaced</u> in lieu of <u>connected</u> to emphasize the fact that the common "hinge" point between contiguous bodies may actually permit relative translational motion of the two bodies at the hinge. The degree of fixity at the hinge is identified by the user via the input integer array IHDATA. A typical body may contain "sensor" points that identify particular points where additional information is required to complete the desired simulation. A sensor point might sense on position or rate for the control system inputs, but could also represent a point on a body where certain other information is desired, such as a momentum wheel location or a point of force/torque application.

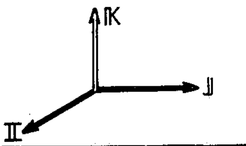
TYPICAL MULTIBODY CONFIGURATION



Legend:

- ⊕ Body Reference Point
- ● Hinge Point
- ◇ Sensor Point
- Momentum Wheel

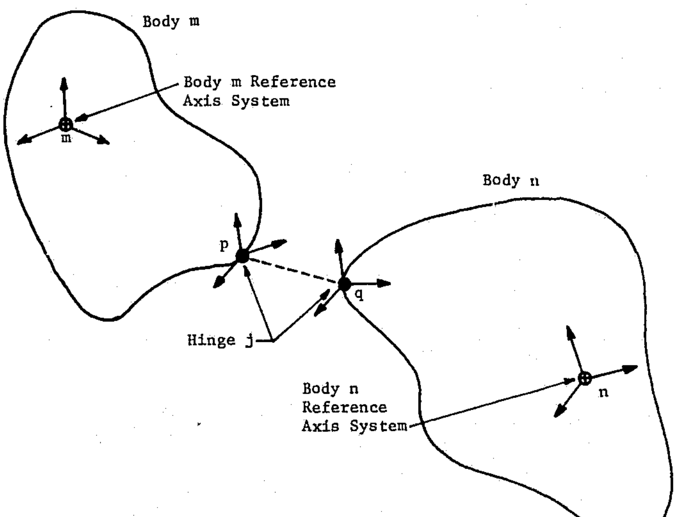
Inertial Reference



Note:

1. All momentum wheels must also have a sensor point,
2. Body I must always be positioned relative to the inertial reference.
3. Hinge 1 is always between Body I and the inertial reference.

TYPICAL TWO BODY/HINGE POINT ARRANGEMENT



Note:

1. Motion of the q frame on Body n is measured relative to the p frame on Body m,
2. The p and q frames are positioned with respect to Body m and n reference axis systems,
3. Hinge j is identified via array ITOPOL,
4. Array IHDATA contains additional hinge information.

FOLDOUT FRAME 1

PROGRAM SIMULATION INTEGER ARRAYS

ITOPOL — Topology, Size = 2 x NH

Hinge No.	1	2	3	4	5	
Body No.	1	3	4	3	2	Body n has frame q
Body No.	0	4	1	1	4	Body m has frame p

Example: Refer to Column 3 (Hinge 3) and note Body 4 interfaces with Body 1 via Hinge 3.

IRGFLX — No. of Elastic Modes/Body, Size

Body No.	1	2	3	4
	5	0	0	2

Example: Body No. 4 has 2 elastic modes, Body No. 2 has no elastic modes.

IFTSMW — Sensor Point Locations, Size = 1

Sensor Pt.	1	2	3	4	5	6
	3	4	2	4	4	3

Example: Sensor Point ◇5 is located on Bo (as are Sensor Points ◇2 and ◇4

IHDATA — Hinge Information, Size = 7 x N

Hinge No.	1	2	3	4	5
ITYPE	3	1	7	2	11
$\dot{\theta}_1$	0	0	0	1	0
$\dot{\theta}_2$	0	0	0	1	2
$\dot{\theta}_3$	0	0	0	0	1
$\dot{x}$	0	1	1	1	1
$\dot{y}$	0	1	0	1	1
$\dot{z}$	0	1	1	1	0

Note:

1. ITYPE = Euler Type
2. Elements in rows 2-7 i hinge constraint type.

0: Free/forced
1: Fixed Constraint (Zero relative velocit
2: Rheonomic Constraint (time dependent)

Additional Remarks:

1. The number of Betas in the state vector equals the sum of "zeros" plus the sum of the "twos" (excluding row 1) in the array.
2. The number of Lambdas (constraints) equals the number of "nonzeros" (excluding row 1) in the array.

IMO — Momentum Wheel Informatio

	1	2	3	Momentum Wheel No.
IMO	5	1	4	Sensor Point No.
	2	1	3	Spin Axis (1, 2, or 3)
AMO	1	1	0	1 = Active; 0 = Constant
	$\dot{\theta}_1$	$\dot{\theta}_2$	$\dot{\theta}_3$	Wheel Rates (Initial)
	J_1	J_2	J_3	Wheel Inertia about Spin

nd
ody

ze = 1 x NB

s,
es.

= 1 x NS

Body 4
4

x NH

identify
e.

ity)

n, Size = 3 x NOFMO and
2 x NOFMO

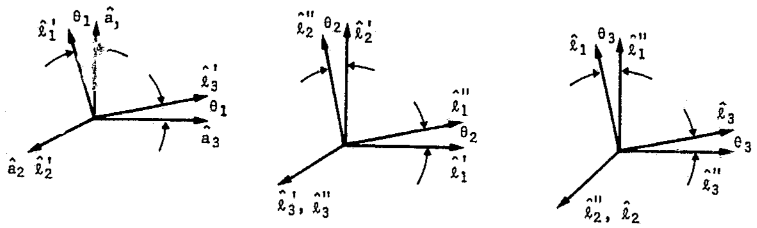
Speed

Axis

EULER ANGLE PERMUTATION CANDIDATES ∿ ITYPE

	ITYPE =	1	2	3	4	5	6	7	8	9	10	11	12
1st Rotation	Axis of θ_1	1	1	1	1	2	2	2	2	3	3	3	3
2nd Rotation	Axis of θ_2	2	2	3	3	3	3	1	1	1	1	2	2
3rd Rotation	Axis of θ_3	3	1	1	2	1	2	2	3	2	3	3	1

Example: Using ITYPE = 6



θ_1 about axis 2 $\quad$ θ_2 about axis 3 $\quad$ θ_3 about axis 2

$$\begin{Bmatrix} \hat{\ell}_1 \\ \hat{\ell}_2 \\ \hat{\ell}_3 \end{Bmatrix} = \begin{bmatrix} C_3 & 0 & -S_3 \\ 0 & 1 & 0 \\ S_3 & 0 & C_3 \end{bmatrix} \begin{bmatrix} C_2 & S_2 & 0 \\ -S_2 & C_2 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} C_1 & 0 & -S_1 \\ 0 & 1 & 0 \\ S_1 & 0 & C_1 \end{bmatrix} \begin{Bmatrix} \hat{a}_1 \\ \hat{a}_2 \\ \hat{a}_3 \end{Bmatrix}$$

also

$$\hat{\ell}_i = {}_iR_j \; \hat{\ell}_j$$

CONSOLIDATION OF KINEMATICAL COEFFICIENTS

(The "b" Coefficients)

Hinge No. \ Body No.	1	2	3	4
1	q			
2			q	p
3	p			q
4	p		q	
5		q		p

$$\begin{Bmatrix} \{U\}_1 \\ \{U\}_2 \\ \{U\}_3 \\ \{U\}_4 \end{Bmatrix} = \begin{Bmatrix} \{\dot{\beta}\}_1 \\ \{\dot{\beta}\}_2 \\ \{\dot{\beta}\}_3 \\ \{\dot{\beta}\}_4 \\ \{\dot{\beta}\}_5 \end{Bmatrix}$$

Note:

1. Only a single entry is in partition for Hinge 1 and it is a q type partition from the connection kinematical array above,
2. All other row partitions have both a p and a q constituent for each "hinge" between contiguous bodies.

CONNECTION KINEMATICS ∿ TYPICAL HINGE

a "p" Point

$$\begin{Bmatrix} \Delta\dot{\theta}_1 \\ \Delta\dot{\theta}_2 \\ \Delta\dot{\theta}_3 \\ \Delta\dot{x}_1 \\ \Delta\dot{x}_2 \\ \Delta\dot{x}_3 \end{Bmatrix} = \left[\begin{array}{c|c|c|c|c} -\pi^{-1}\,{}_qR_p\;{}_pR_m & & -\pi^{-1}\,{}_qR_p\;{}_pR_m\;\sigma_p & +\pi^{-1}\;{}_qR_n & \\ \hline -{}_pR_m\;S_{mp} & -{}_pR_m & -{}_pR_m\;h_p & {}_pR_q\;{}_qR_n\;S_{nq} & \end{array} \right.$$

Note:

1. ${}_iR_j$ is a rotation transformation from the j to the i reference frame.
2. In general, ${}_iR_j\;{}_jR_k = {}_iR_k$ and

   π^{-1} is a transformation relating Euler rates to body axes projections of the angular velocity vector,

   σ_i is a modal slope matrix in the i frame,

   h_i is a modal deflection matrix in the i frame,

   S_{ij} is a skew symmetric matrix whose elements are the components of the vector i to j in the ith frame.

CONSTRAINT FORCE/TORQUE VECTOR

$$\{\lambda\} = \begin{Bmatrix} \lambda_1 \\ \lambda_2 \\ \lambda_3 \\ \lambda_4 \\ \lambda_5 \\ \lambda_6 \\ \lambda_7 \\ \lambda_8 \\ \lambda_9 \\ \lambda_{10} \\ \lambda_{11} \\ \lambda_{12} \\ \lambda_{13} \\ \lambda_{14} \end{Bmatrix} \quad \begin{matrix} (F_x)_2 \\ (F_y)_2 \\ (F_z)_2 \\ (F_x)_3 \\ (F_z)_3 \\ (T_1)_4 \\ (T_2)_4 \\ (F_x)_4 \\ (F_y)_4 \\ (F_z)_4 \\ (T_2)_5 \\ (T_3)_5 \\ (F_x)_5 \\ (F_y)_5 \end{matrix}$$

$(F_x)_i$ refers to Hinge i

STATE

{y} =

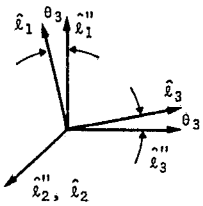
FOLDOUT FRAME 2

11	12
3	3
2	2
3	1

CONNECTION KINEMATICS ∿ TYPICAL HINGE

a "p" Point — a "q" Point

$$\begin{Bmatrix}\Delta\dot\theta_1\\ \Delta\dot\theta_2\\ \Delta\dot\theta_3\\ \Delta\dot x_1\\ \Delta\dot x_2\\ \Delta\dot x_3\end{Bmatrix} = \left[\begin{array}{ccc|ccc} -\pi^{-1}\,{}_qR_p\,{}_pR_m & & -\pi^{-1}\,{}_qR_p\,{}_pR_m\,\sigma_p & +\pi^{-1}\,{}_qR_n & & +\pi^{-1}\,{}_qR_n\,\sigma_q \\ \hline -{}_pR_m\,S_{mp} & -{}_pR_m & -{}_pR_m\,h_p & {}_pR_q\,{}_qR_n\,S_{nq} & {}_pR_q\,{}_qR_n & {}_pR_q\,{}_qR_n\,h_q\end{array}\right]\begin{Bmatrix}\{\tilde U_n\}\\ \{\tilde U_m\}\end{Bmatrix}$$



θ_3 about axis 2

Note:

1. ${}_iR_j$ is a rotation transformation from the j to the i reference frame.
2. In general, ${}_iR_j\,{}_jR_k = {}_iR_k$ and

   π^{-1} is a transformation relating Euler rates to body axes projections of the angular velocity vector,

   σ_i is a modal slope matrix in the i frame,

   h_i is a modal deflection matrix in the i frame,

   S_{ij} is a skew symmetric matrix whose elements are the components of the vector i to j in the ith frame.

$$\{\tilde U_j\} = \begin{Bmatrix}\omega_x\\ \omega_y\\ \omega_z\\ u\\ v\\ w\\ \dot\xi_1\\ \dot\xi_2\\ \cdot\\ \cdot\\ \cdot\\ \dot\xi_n\end{Bmatrix}_j$$

CONSTRAINT FORCE/TORQUE VECTOR

$$\{\lambda\} = \begin{Bmatrix}\lambda_1\\ \lambda_2\\ \lambda_3\\ \lambda_4\\ \lambda_5\\ \lambda_6\\ \lambda_7\\ \lambda_8\\ \lambda_9\\ \lambda_{10}\\ \lambda_{11}\\ \lambda_{12}\\ \lambda_{13}\\ \lambda_{14}\end{Bmatrix} \quad \begin{matrix}(F_x)_2\\ (F_y)_2\\ (F_z)_2\\ (F_x)_3\\ (F_z)_3\\ (T_1)_4\\ (T_2)_4\\ (F_x)_4\\ (F_y)_4\\ (F_z)_4\\ (T_2)_5\\ (T_3)_5\\ (F_x)_5\\ (F_y)_5\end{matrix}$$

$(F_x)_i$ refers to Hinge i

STATE VECTOR ARRANGEMENT

$$\{y\} = \begin{Bmatrix}\{U\}_1\\ \{U\}_2\\ \{U\}_3\\ \{U\}_4\\ \{\xi\}_1\\ \{\xi\}_2\\ \{\xi\}_3\\ \{\xi\}_4\\ \beta_1\\ \beta_2\\ \beta_3\\ \beta_4\\ \beta_5\\ \beta_6\\ \beta_7\\ \beta_8\\ \beta_9\\ \beta_{10}\\ \beta_{11}\\ \beta_{12}\\ \beta_{13}\\ \beta_{14}\\ \beta_{15}\\ \beta_{16}\\ \beta_{17}\\ \delta_1\\ \delta_2\\ \delta_3\end{Bmatrix} ; \quad \{\dot y\} = \begin{Bmatrix}\{\dot U\}_1\\ \{\dot U\}_2\\ \{\dot U\}_3\\ \{\dot U\}_4\\ \{\dot\xi\}_1\\ \{\dot\xi\}_2\\ \{\dot\xi\}_3\\ \{\dot\xi\}_4\\ \dot\beta_1\\ \dot\beta_2\\ \dot\beta_3\\ \dot\beta_4\\ \dot\beta_5\\ \dot\beta_6\\ \dot\beta_7\\ \dot\beta_8\\ \dot\beta_9\\ \dot\beta_{10}\\ \dot\beta_{11}\\ \dot\beta_{12}\\ \dot\beta_{13}\\ \dot\beta_{14}\\ \dot\beta_{15}\\ \dot\beta_{16}\\ \dot\beta_{17}\\ \dot\delta_1\\ \dot\delta_2\\ \dot\delta_3\end{Bmatrix} \quad \text{where } \{U\}_j = \begin{Bmatrix}\omega_x\\ \omega_y\\ \omega_z\\ u\\ v\\ w\\ \dot\xi_1\\ \dot\xi_2\\ \cdot\\ \cdot\\ \cdot\\ \dot\xi_{NE}\\ \dot\theta_1\\ \dot\theta_2\\ \cdot\\ \cdot\\ \cdot\\ \dot\theta_M\end{Bmatrix}_j$$

← For this example, $\dot\beta_{16}$ prescribed as function of time, i.e., a rheonomic constraint as noted in IHDATA

$$\begin{Bmatrix}\{U\}_1\\ \{U\}_2\\ \{U\}_3\\ \{U\}_4\end{Bmatrix} = \begin{Bmatrix}\{\dot\beta\}_1\\ \{\dot\beta\}_2\\ \{\dot\beta\}_3\\ \{\dot\beta\}_4\\ \{\dot\beta\}_5\end{Bmatrix}$$

Figure I.B-1 Simulation Nomenclature

ORIGINAL PAGE IS
OF POOR QUALITY

FOLDOUT FRAME 3

The integer input array IFTSMW identifies the body, where a particular sensor point is located.

A body may also contain "momentum wheels". This special consideration accommodates a disk or rotating mass with a single relative rotational degree of freedom into the simulation without introducing another body. The momentum wheel capability is more efficient for the simulation of a single degree of freedom rotating mass than is constraining 5 of 6 rigid body degrees of freedom via constraint equations. All momentum wheels must have an associated sensor point. A wheel may either be active or constant speed; an active wheel has a variable spin rate and receives an input torque (generally via some sensor output relationship) and a shaft torque is applied to the wheel inducing a wheel angular acceleration. The array IMO identifies whether or not the wheel is active, and which axis is the spin axis. The reference axis for the wheel is the same as the sensor point axis system where the wheel is located. The array AMO identifies the wheel spin rates (initial rate only for the active wheel) and the wheel spin inertia about the spin axis.

The system state vector is arranged in a specific manner within the program and it is necessary for the user to be very familiar with this arrangement for a number of reasons. First, the user must know where certain variables are located so that he can couple the control law into the simulation, and secondly, the user must know the order of the state variables in order to interpret results. Figure I.B-1 presents the state variable order consistent with the illustrative problem and other related information. The state variables shown do indeed represent a typical arrangement in that all of the various types of variables resulting from the multiple options available within the simulation are present. The order of the constraints (λ) is also noted. Note that the user introduces the control variables into the state vector but these variables (δ) will always appear after the betas (β). Furthermore, the user may also introduce auxiliary variables (plant sensor signals and control system outputs) for use in the linearized studies. These auxiliary variables should be placed (by the user) after the control variables (δ) and in the order: plant sensor signals (X_{SS}) followed by the control system outputs (B).

C. GUIDELINES

There are a number of guidelines that must be adhered to in setting up a particular simulation. Some were detailed previously and are concisely summarized here:

1. there must be at least two bodies; a single body problem is simulated by including a dummy body that is not connected to the body to be analyzed;

2. body no. 1 is always positioned relative to the inertial reference;

3. bodies are numbered from 1 to NB in an arbitrary order;

4. every body (except body 1) must have at least <u>one</u> hinge; body 1 must have at least two hinges;

5. hinges are numbered from 1 to NH in an arbitrary order but hinge no. 1 is, by definition, the hinge on body 1 between body 1 and the inertial origin; hence, hinge no. 1 can only appear on body 1;

6. there must be at least one sensor point for a given simulation;

7. sensor points are numbered from 1 to NS in an arbitrary manner;

8. a typical flexible body requires mass and modal data that reflects a coordinate system that is consistent with the body axis reference system for that body, e.g., a modal coupling approach establishing modal properties for a given body would have to use the same reference body axis system;

9. for frequency domain studies, there can only be as many control output variables identified to introduce into the state equations as there are control system variables to begin with. Similarly, there can be no more sensor signal variables identified than plant variables which appear in the original independent state equations.

10. the user must make certain that the user supplied package has dimensions consistent with NHMAX for the arrays

SK(NSK, NHMAX), DK(NDK, NHMAX), and HNGT(NHT, NHMAX)

where NHMAX = dimensioned maximum number of hinges,

NSK = 3 or 6 depending upon nature of hinge freedom,

NDK = 3 or 6 depending upon nature of hinge freedom,

NHT = 3 or 6 depending upon nature of hinge freedom,

and if rotation only, then NSK = NDK = NHT = 3, if rotation and translation, then NSK = NDK = NHT = 6;

11. the inertial properties of all the momentum wheels in a particular body must be included in that body's inertia description (whether rigid or flexible) since inertial coupling is used.

II. DYNAMO SEGMENTATION

The digital code has been segmented into an executive overlay which governs the succeeding program flow and five supporting primary overlays, each with a separate and dedicated purpose. The basic program flow is depicted in Figure II.A-1.

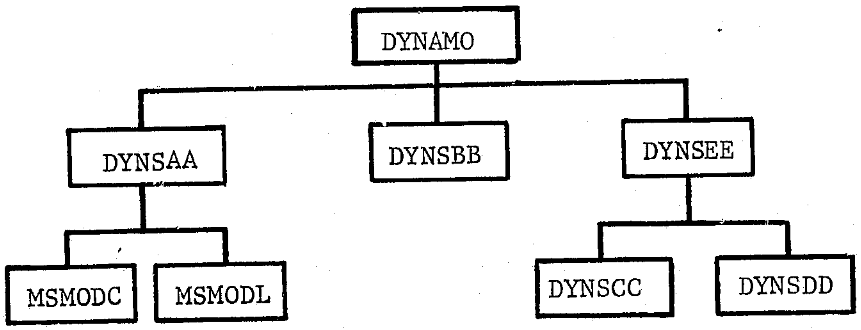


Figure II.A-1. DYNAMO Segmentation

Table II.A-1 summarizes the intended purpose of the fundamental components in the program structure.

Table II.A-1 DYNAMO Overlay Description

Primary Overlays	
Segment Name	Purpose
DYNAMO	Executive program control
DYNSAA	Data input
DYNSBB	Simulation of problem, linearization of state eq's, nonlinear time response
DYNSEE	Control routine for DYNSCC and/or DYNSDD
DYNSCC	Plot results from nonlinear or linearized time response
DYNSDD	Frequency domain analysis, linearized time response, frequency domain displays, (Bode, Nichols, Nyquist, Root Locus)
Secondary Overlays (called from DYNSAA)	
MSMODL	Flexible body data inputs for lumped mass representation
MSMODC	Flexible body data inputs for consistent mass representation

The executive overlay (DYNAMO) initiates the simulation by reading job identification information and then passes control to the first primary overlay (DYNSAA) which represents the basic data input segment. This overlay may be viewed as the program segment which builds the model from the input data. A series of topology checks are made as the data is loaded within this overlay to better assure proper modeling of the physical system. This overlay utilizes two additional secondary overlays for processing certain types of inertial and modal data.

After overlay DYNSAA has structured the basic data for simulation, control is returned to the executive overlay which in turn passes control on to the second overlay DYNSBB. This overlay performs the actual problem mechanization and develops the nonlinear formulation which is the foundation for the entire dynamic simulation program.

During a given simulation, the executive overlay always calls the first three overlays (DYNSAA, DYNSBB and DYNSEE) but, depending upon certain input control parameters, may or may not call the time history plot overlay DYNSCC or the linearized system analysis overlay DYNSDD. This option is controlled through the call to DYNSEE.

Simulation of a particular problem has its basis within the algorithms contained in the program subroutine YDØT which establishes the canonical first-order differential equations that govern the dynamical motion. This routine in turn addresses another subprogram TØRQUE which in turn activates the user supplied modules that relate to the particular simulation being considered. These modules are discussed in further detail in a following section.

III. THE USER-PAKS

The program has been written under the assumption that certain user-supplied modules are available to complete a given problem. In this manner, the user has considerable latitude with regard to how certain particulars related to a given simulation are to be handled. Control law specification, external torque inputs, and identification of plant sensor signals and control system outputs are examples of items handled by the user. With this concept in mind, several subprograms have been placed under user control but with certain restrictions and guidelines to which the user must adher. Later comments will identify certain requirements associated with these user supplied modules.

A. LOGIC FLOW

It is worthwhile to consider a flow chart segment of the program (Figure III.A-1) and its chronology within the solution process. The order which the user supplied modules are called is indicated by the integers 1 through 7 (for subroutines) and 8 and 9 for functions.

B. SPECIFIC CONSIDERATIONS

The separate user supplied subprograms each have specific intended purposes and have been coded to fulfill these goals. The user can extend the scope of any of these modules with his own code, but there are certain items that these routines must perform. In any case, the potential user should be very familiar with many of the details of the user supplied package, and it is with this fact in mind that a separate discussion will now be devoted to each of the user supplied modules. Reference will be made to some of the programming logic contained in the DYNAMO subroutine TØRQUE, and so this logic has been put into flow chart form as Figure III.B-1.

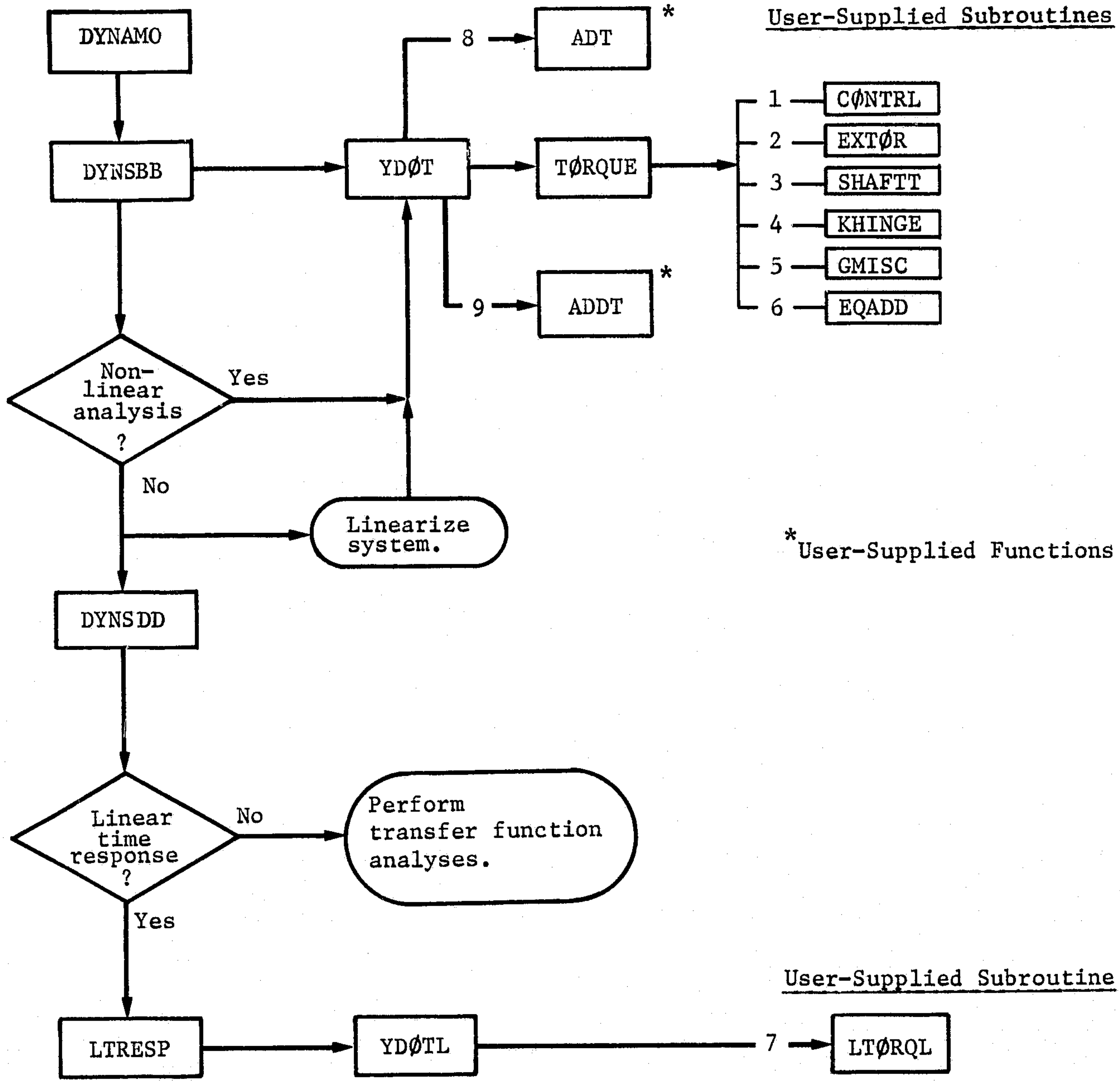
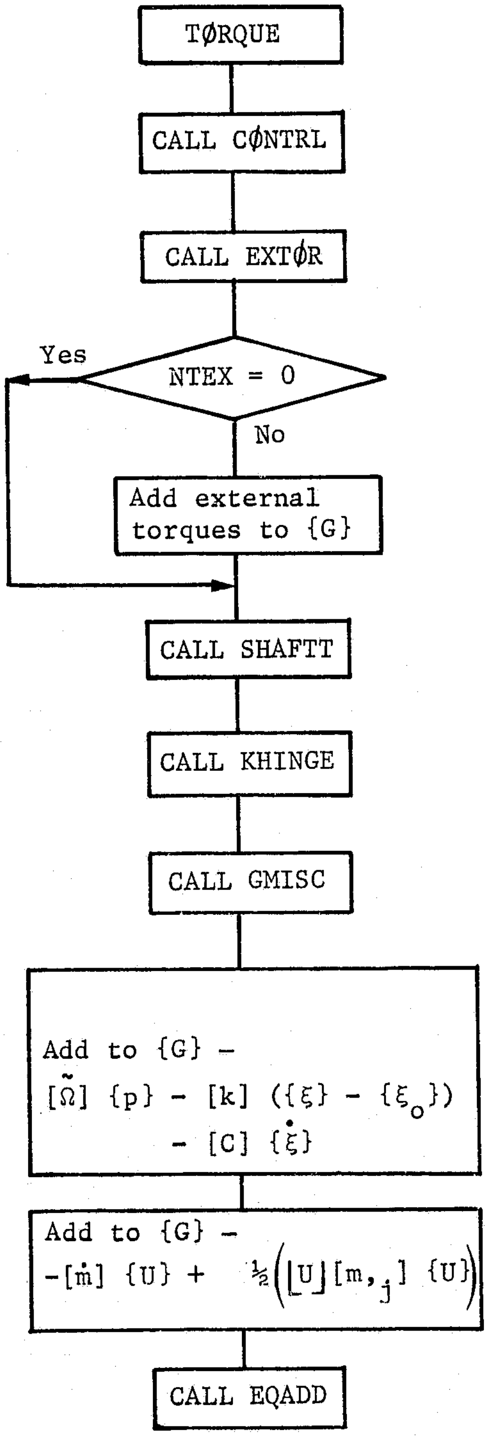


Figure III.A-1 User Pak Logic



Creates external torques/forces

Note: {G} is force/torque vector ∿ RHS of equation of motion

Adds momentum wheel shaft torques to {G}

Adds hinge spring torques to {G} and sums spring energy to potential energy

Gets $\Delta\xi$ due to thermal environment

Now have RHS of equations of motion

Creates additional equations for similarity transformation (used in linearization and stability package)

Figure III.B-1 Subroutine TORQUE Flow Diagram

1. CØNTRL

This is the first of the user-supplied routines and is always called by DYNSBB. The primary purpose of CØNTRL is to establish the time derivatives of the control system variables. These variables may be required by some of the other user routines that are activated after CØNTRL has been addressed. The routine must also establish the number of plant sensor signals (NXSS) and the number of control system outputs (NBTQ) which are transmitted through common block (/LDSIZE/) to the remainder of the program. For transfer function studies, the user is also required to identify whether or not transfer function polynominals are to be utilized. This is accomplished in a data statement (in CØNTRL) with the variable NPLY which is the number of polynominal ratio pairs (numerator and denominator) to be utilized. The first call to CØNTRL will read in the polynominal coefficients (for NPLY $\neq$ 0).

Subroutine CONTRL contains a good deal of information pertaining to the simulation by virtue of its common blocks. Section C identifies the constiuents of the common blocks contained in this and other modules. Additional common blocks can be established by the program user to transfer information between the separate user-pak modules.

2. EXTØR

This subroutine establishes the system external torques. Typically, this module can be utilized to accommodate such items as RCS (Reaction Control System) forces and torques, aerodynamics, and/or solar wind. The user can also extend this routine to include the addition of other state dependent torques. In summary, EXTØR, can be used as a "catch all" for inclusion of any additional forces and torques acting on the system. A single call to EXTØR from subroutine TØRQUE establishes an integer array (ISNP) whose elements identify which sensor points are to be used for force/torque inputs. A vector containing torque and force components (ordered: T_x, T_y, T_z, F_x, F_y, F_z) is then established for each of the force/torque sensor points and placed as a column into the array TEX. The vector of discrete forces and torques (referred to the local sensor-axis system) is returned to subroutine TØRQUE from EXTØR. These forces and torques are then transformed and added to the total system external force/torque array $\{G\}$. The user can bypass EXTØR related calculations by setting the variable NTEX equal to zero.

3. SHAFTT

This routine establishes the shaft torque for each of the non-constant speed momentum wheels. Zeros are inserted for the torque contributions to the external torque vector for a constant speed wheel.

4. KHINGE

This routine sets up hinge spring and dashpot torques/forces. It also accounts for potential energy contributions due to hinge spring deflections. The user must identify where spring rates and dashpot constants are to be found. This can easily be handled by a user specified equivalence statement within subroutine KHINGE to locate the leading stiffness and damping elements within the data block identified as CNTDTA. Note: within subroutine KHINGE there are statements of the following form

```
DIMENSION SK(3, NHMAX), DK(3, NHMAX), HNGT(3, NHMAX)
      .
      .
      .
DO 10 I=1,3
      .
      .
DO 15 I=1,3
      .
      .
DO 20 I=1,3
      .
      .
```

where the integer 3 reflects the fact that consideration has been restricted to admitting only rotational springs at each hinge. If the user wants to also include springs/dashpots in relative translation at the hinge points, the three (3) in the statements above must be changed to a six (6), and appropriate spring rates and/or dashpots included within the data input array CNTDTA. Further, the equivalence statement locating the first spring rate (SK(1)) and dashpot constant (DK(1)) reflect an order that is consistent with the hinge order; that is the first three elements in CNTDTA starting with the location corresponding to the leading element of SK represents in order $K\theta_1$, $K\theta_2$, $K\theta_3$ for the first hinge. A similar relationship exists

for the array DK.

Example: In KHINGE note that

EQUIVALENCE(CNTDTA(K),SK(1)),(CNTDTA(L),DK(1))

and the array CNTDTA would by

$$\text{CNTDTA} = \;\ldots\; \underbrace{K_{\theta_1}\ K_{\theta_2}\ K_{\theta_3}}_{\substack{\text{Hinge 1}\\ \text{(springs)}}} \;\ldots\; \underbrace{K_{\theta_1}\ K_{\theta_2}\ K_{\theta_3}}_{\substack{\text{Hinge NH}\\ \text{(springs)}}} \;\ldots$$

element(K)

element(L)

$$\ldots\; \underbrace{C_{\dot\theta_1}\ C_{\dot\theta_2}\ C_{\dot\theta_3}}_{\substack{\text{Hinge 1}\\ \text{(dashpots)}}} \;\ldots\; \underbrace{C_{\dot\theta_1}\ C_{\dot\theta_2}\ C_{\dot\theta_3}}_{\substack{\text{Hinge NH}\\ \text{(dashpots)}}} \;\ldots$$

where the order of $\theta_{1,2,3}$ is consistent with the Euler rotation type (1-12) for the hinge "q" triad.

The remainder of KHINGE is concerned with the proper placement of the spring/dashpot forces and torques onto the composite NB bodies (generalization of forces and torques) and should remain unchanged.

The user can modify the referenced torques and forces immediately after the (DØ 10 L=1,NH) loop if he desires, but care must be taken to assure that the proper force or torque is correctly applied to accomplish the desired result.

5. GMISC

This routine is reserved to implement torque/force contributions from thermal gradient effects. The entire state vector, along with component position and attitude information, is available via transfer through labeled common arrays. Section C provides more insight into the information contained in these common blocks.

6. EQADD

This routine establishes additional equations for use in the linearized time domain analyses. It must identify the number

of additional equations introduced via the variable NAUX (number of auxiliary equations). These equations relate plant sensor signals, X_{ss}^{i} and control system output forces/torques, B^{i}, to the system state and in the specified order. The additional variables must be placed in the state vector as the last NAUX state variables and in the order, X_{ss}^{i} , then B^{i} and they become an integral part of system transfer function evaluations.

7. LTØRQL

This routine establishes the $b_{ik}U^{k}$ portion of the right hand side of

$$\dot{z}^{i} = A_{ij}z^{j} + b_{ik}U^{k}$$

which is used for the linearized time response. This corresponds to the external excitations for the transformed variables, z^{i}, leading to evaluation of the perturbation response.

8. ADT (Subfunction)

This function is used in conjunction with ADDT to implement prescribed kinematical motion in the hinge coordinates. With reference to Figure I.B-1, the array IHDATA(I,J),I> 1, may have 2 as an entry indicating that the Jth hinge has velocity and acceleration prescribed in that coordinate. The argument of this subfunction is: ADT(IC,T), with IC=6*(J-1)+(I-1) corresponding to IHDATA(I,J)=2. The integer IC and the time T are passed into ADT via argument by the calling subroutine so that the velocity ($\dot{\alpha}$) may be established for the proper hinge coordinate as a function of time.

For a given rheonomic constraint, we note that both $\dot{\alpha}$ and $\ddot{\alpha}$ must be set by subfunction. Now, it is conceivable that the user knows $\ddot{\alpha}$ as the exact mathematical time derivative of $\dot{\alpha}$. It would seem that the natural thing to do would be to create ADT and ADDT subfunctions to return consistent $\dot{\alpha}$ and $\ddot{\alpha}$ respectively. This is not the best thing to do, however, because of numerical integration characteristics. The numerical integration of $\{\dot{U}\}$ reflects the use of $\ddot{\alpha}$. The resulting $\{U\}$ reflects a numerically integrated $\dot{\alpha}$ which cannot be consistent with a value obtained any way other than numerical integration. The consequences of this are seen as slight errors in motion response, but also, there is a large spurious change in system momenta.

The best way to effect rheonomic constraints is to use values of $\dot{\alpha}$ obtained from numerically integrating $\ddot{\alpha}$. This can be easily done by using additional differential equations that are accommodated in the state vector as additional "control variables" or $\{\delta\}$. Thus, after all of the actual control variable rates are established (in subroutine CØNTRL) one need only code additional expressions to set $\dot{\delta}$(additional) = $\ddot{\alpha}$(desired). The statements within subfunction ADT merely return ADT=Y(K); the state vector Y is available in labeled common /VECTOR/, and K corresponds to the location in Y where the $\delta = \dot{\alpha}$ control variable resides. Of course, IC must be tested such that the appropriate $\dot{\alpha} = \delta$ is returned.

9. ADDT (Subfunction)

This function is discussed with regard to its relationship to ADT in Section (8) above. This function has arguments: ADDT(IC,T), exactly the same as ADT, and returns values of $\ddot{\alpha}$ for appropriate IC and T consistent with the $\dot{\alpha}$ returned by ADT. Note in Figure III.A-1,the chronology is such that subroutine CØNTRL is addressed prior to function ADDT. This is so that CØNTRL can establish a value of $\dot{\delta}$(additional) = $\ddot{\alpha}$(desired) to put in the state vector time derivative (YDT, also available in labeled common/VECTOR/). Now, for the appropriate time T and IC, it is only necessary to set ADDT=YDT(K), where again K corresponds to the location in Y where the $\delta = \dot{\alpha}$ auxiliary control variable resides.

C. DELINEATION OF COMMON BLOCK DATA

The program user will very often have a need to access certain information that is calculated and stored within the program in order to compute specific variables required for the user supplied modules. Such information about the simulation is stored in multi-dimensional array form within labeled common blocks. These data provide a good supplement to the state variable content which has been previously discussed in that the user can extract both total and relative positions and rates for any component of the simulated dynamical system once he has a firm understanding of where certain data reside within the program. The following subsections will discuss selected common block arrays to better familiarize the potential user with their content.

1. Common block/BHBSRD/ contains three separate groups of information which the user may need to access. This information is concisely summarized in double and/or triple subscripted arrays as

BS(6,6+NMDBOD,NSPMAX)

ROL(3,3,NBMAX)

DOL(3,NBMAX)

where the following items are noted -

NMDBOD = maximum dimensioned number of modes per body,

NBMAX = maximum dimensioned number of bodies,

NSPMAX = maximum dimensioned number of sensor points.

The array, BS(i,j,k), contains the kinematical coefficients for all of the "sensor" points. The rows (subscript i=1,2...6) of the array refer to (in order: ω_x, ω_y, ω_z, u, v, w) the components of absolute angular and translational velocity (sensor referenced) at sensor point k. The columns of the array (subscript j) refer to the j=1,2,...6 + no. of elastic modes on body containing sensor point k. Thus, in general, if we want to know the projection (the ith velocity component) onto the triad located at sensor point k, the following expression is noted

$$\mathrm{Vel}_i = \mathrm{BS}(i,j_1,\ldots,j_L,k) \cdot \tilde{U}^j \quad .$$

The array, ROL(i,j,k) contains the rotation transformations relating the body axis systems to the inertial reference. The elements of the array are the direction cosines between the body axes, $\hat{e}_k$, and the fixed inertial system, $\hat{e}_o$. Subscript k denotes the body number.

The array DOL(i,k) contains the three vector components, (X, Y, Z), from the inertial reference to the body axis system, $\hat{e}_k$, for each body.

2. Common block /SPECIF/ contains information which the user may require. These arrays are

BETAH(6,NHMAX)

BETAHD(6,NHMAX)

RS(3,3,2*(NSPMAX))

DS(3,2*(NSPMAX))

where the following items are noted -

NHMAX = maximum dimensioned number of hinges,

NSPMAX = maximum dimensioned number of sensor points.

The arrays BETAH(i,j) and BETAHD(i,j) contain the hinge BETA's and rates respectively (for hinge j). The order (i subscript) is given as

$$\begin{bmatrix} \dot{\theta}_1 \\ \dot{\theta}_2 \\ \dot{\theta}_3 \\ \dot{\Delta}_1 \\ \dot{\Delta}_2 \\ \dot{\Delta}_3 \end{bmatrix}$$

where $\dot{\theta}_i$ is the ith Euler angle rate consistent with ITYPE for hinge j and $\dot{\Delta}_i$ is the ith velocity component of point q relative to point p in the p frame for hinge j.

The array RS(i,j,k) contains the rotation transformations (direction cosines) between the sensor point axis system and the body axis system (body on which sensor is located). Two sets of transformations are identified for a given sensor point. The first represents misalignment of the two triads without elastic deformation and the second includes the elastic deformation. The ordering (subscript k) proceeds as follows: the ℓth sensor rotation (without elastic deformation) is located at $k = 2*\ell-1$. The total rotation transformation for the ℓth sensor is located at $k = 2*\ell$. For a rigid body, these two transformations are identical.

The array DS(i,k) contains the three components of the vector from the body axis system to the body sensor points (in the body axis system). Here again, there are two sets of vectors (rigid body and rigid body + elastic) for each sensor point. The first is for rigid body and the second includes the elastic deformation. The addressing algorithm is the same as for RS(i,j,k).

IV. DYNAMO INPUT REQUIREMENTS

The dynamic simulation program utilizes some basic data input subroutines in an attempt to standardize a large amount of the bulk data input. Additional formatted inputs have been used where it is more meaningful (and more efficient) to do so. As will be noted in the following section, there is a large amount of data input via subroutines READ and READIM. Therefore, it is useful to familiarize the reader with these two routines prior to describing overall program data input requirements.

A. BASIC DATA INPUT ROUTINES READ AND READIM

These two subprograms are structured to read matrix arrays in floating point (real) notation (subroutine READ) or fixed point (integer) notation (subroutine READIM). A thorough discussion of the routines and their supporting subroutines is available at MSFC.* The following discussion gives a cursory overview of their usage.

The routines are activated by a FORTRAN call of the form:

```
CALL READ (A, NR, NC, KR, KC)  or

CALL READIM (IA, NR, NC, KR, KC)
```

where the arguments in the call statement are

A, (IA) = floating (fixed) matrix array of size NR by NC

NR = number of rows in array

NC = number of columns in array

KR = row dimension of array in calling program

KC = column dimension of array in calling program

A call to either of these input routines requires that the data be in the following format:

---

* R. L. Wohlen. Synthesis of Dynamic Systems Using FORMA-Fortran Matrix Analysis. Contract NAS8-25922. MCR-71-75. Martin Marietta Corporation, Denver, Colorado, May 1971

1. Subroutine READ

First card - matrix name, NR, NC with format (A6,I4,I5)

Middle cards - data with format (2I5, 4D17.8)

first I5 is row number
second I5 is column number of leading D17.8 field
next 4D17.8 are elements of the array

Last card - ten zeros in columns 1 through 10

2. Subroutine READIM

First card - matrix name, NR, NC with format (A6,I4,I5)

Middle cards - data with format (2I5, 14I5)

first I5 is row number
second I5 is column number of leading I5 field
next 14I5 are elements of the array

Last card - ten zeros in columns 1 through 10

B. INPUT DATA STREAM

This section presents the program system input data stream together with the data input control logic. The approach taken herein is to first introduce an overview of the data inputs and program control logic in the form of a flow diagram (Figure IV.B-1) and to then identify the details in much the same way as the FORTRAN code accepts the data inputs. This method of presentation has been chosen as it most closely relates to the actual processing of the user inputs for a given simulation. In addition, the user can follow the program control or switching logic to determine just what data are required to complete a particular simulation.

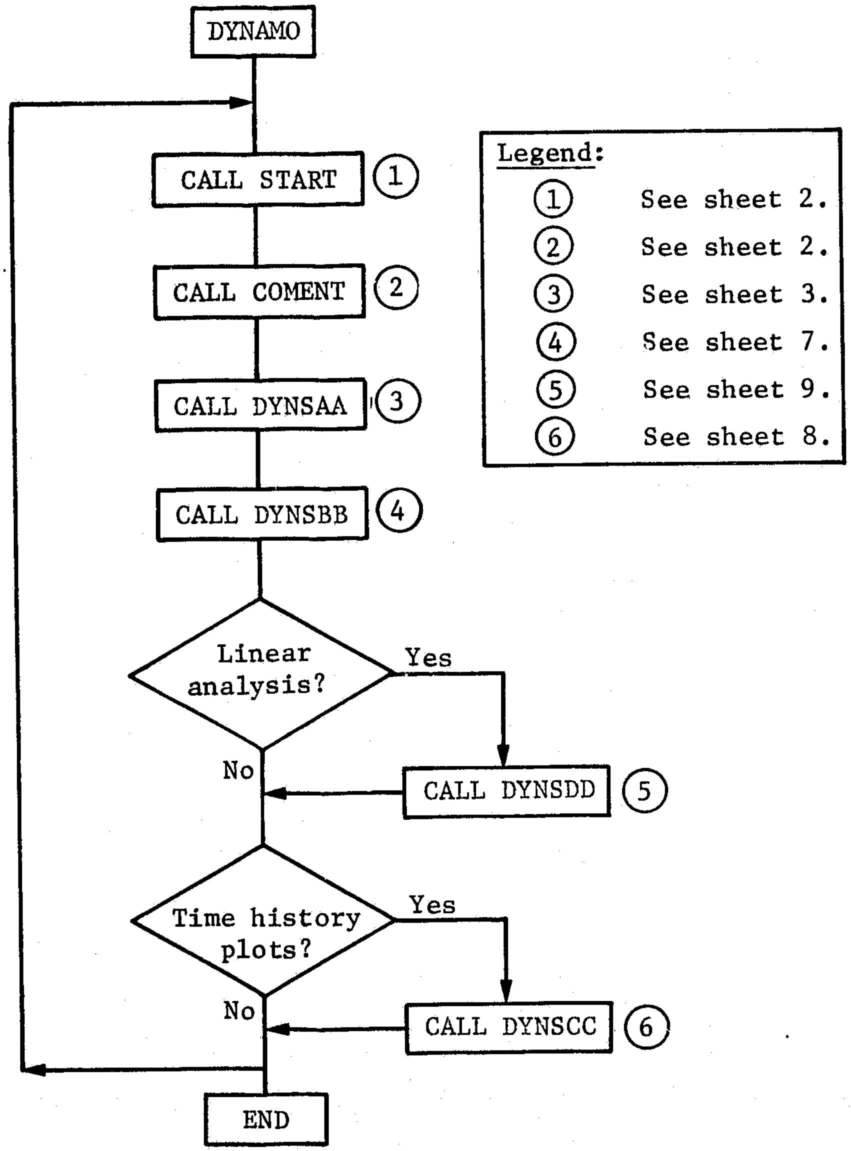


Figure IV.B-1
Program System DYNAMO Data Stream Flow (Sheet 1 of 9)

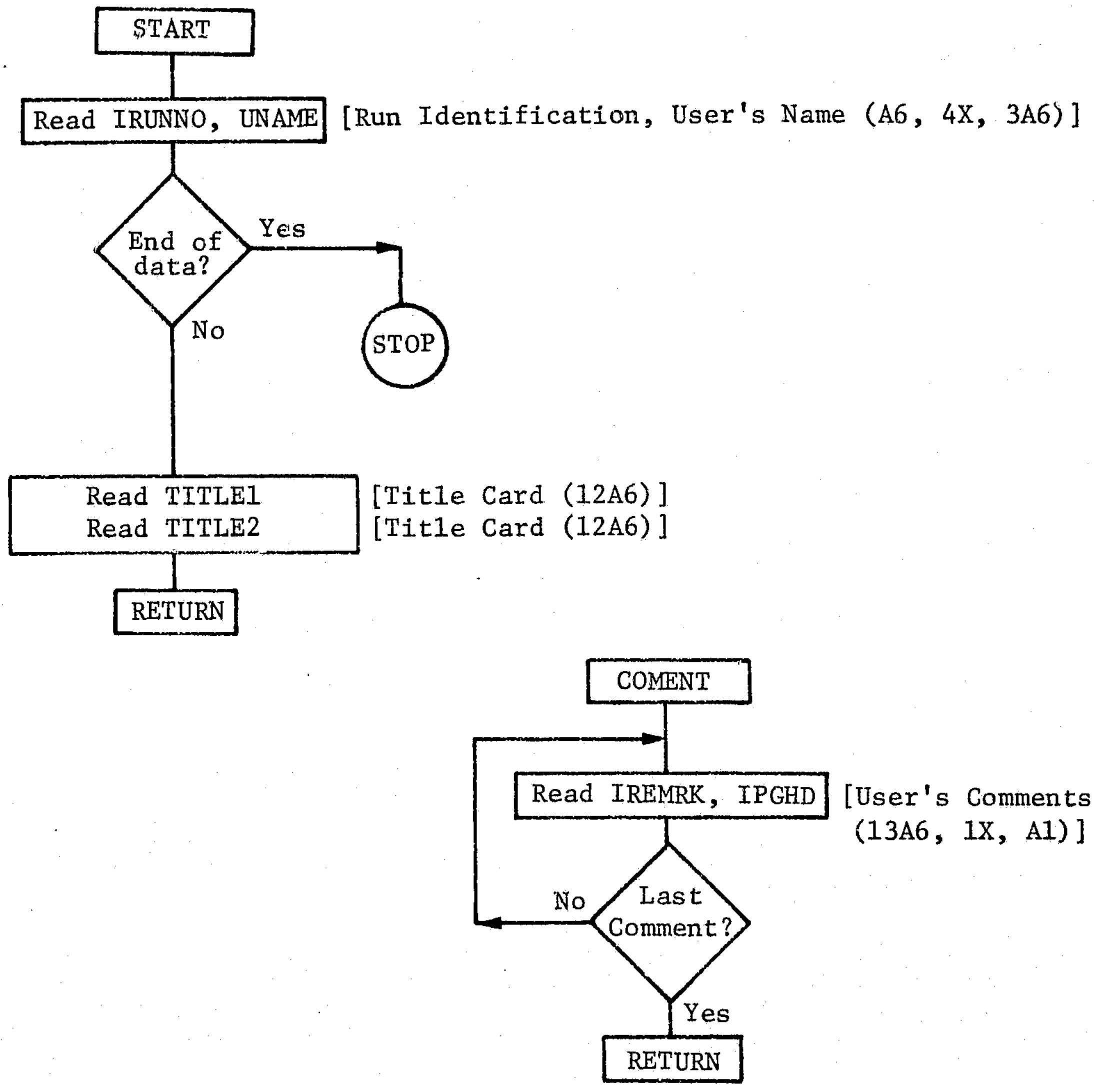


Figure IV.B-1
Program System DYNAMO Data Stream Flow (Sheet 2 of 9)

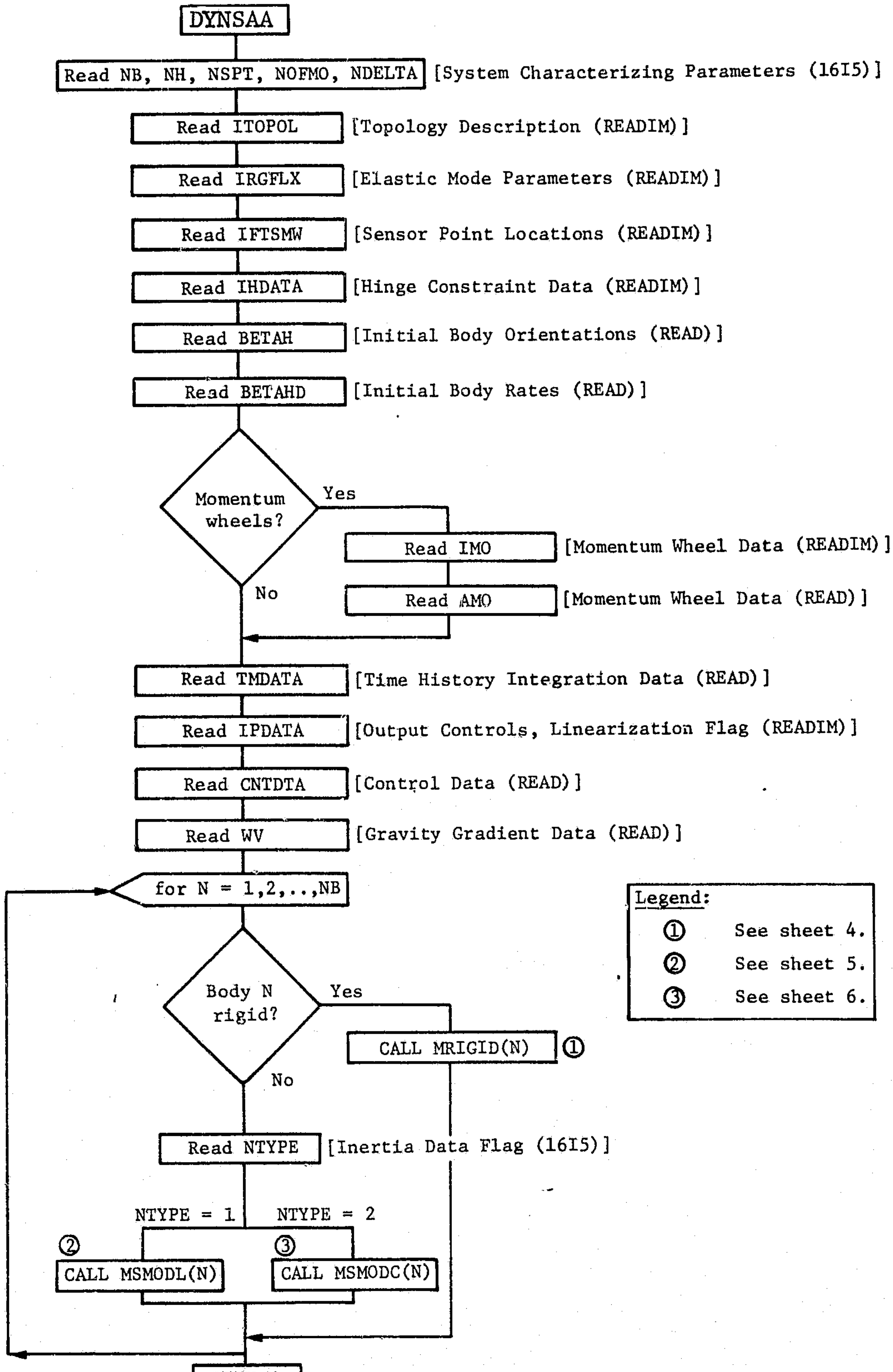


Figure IV.B-1
Program System DYNAMO Data Stream Flow (Sheet 3 of 9)

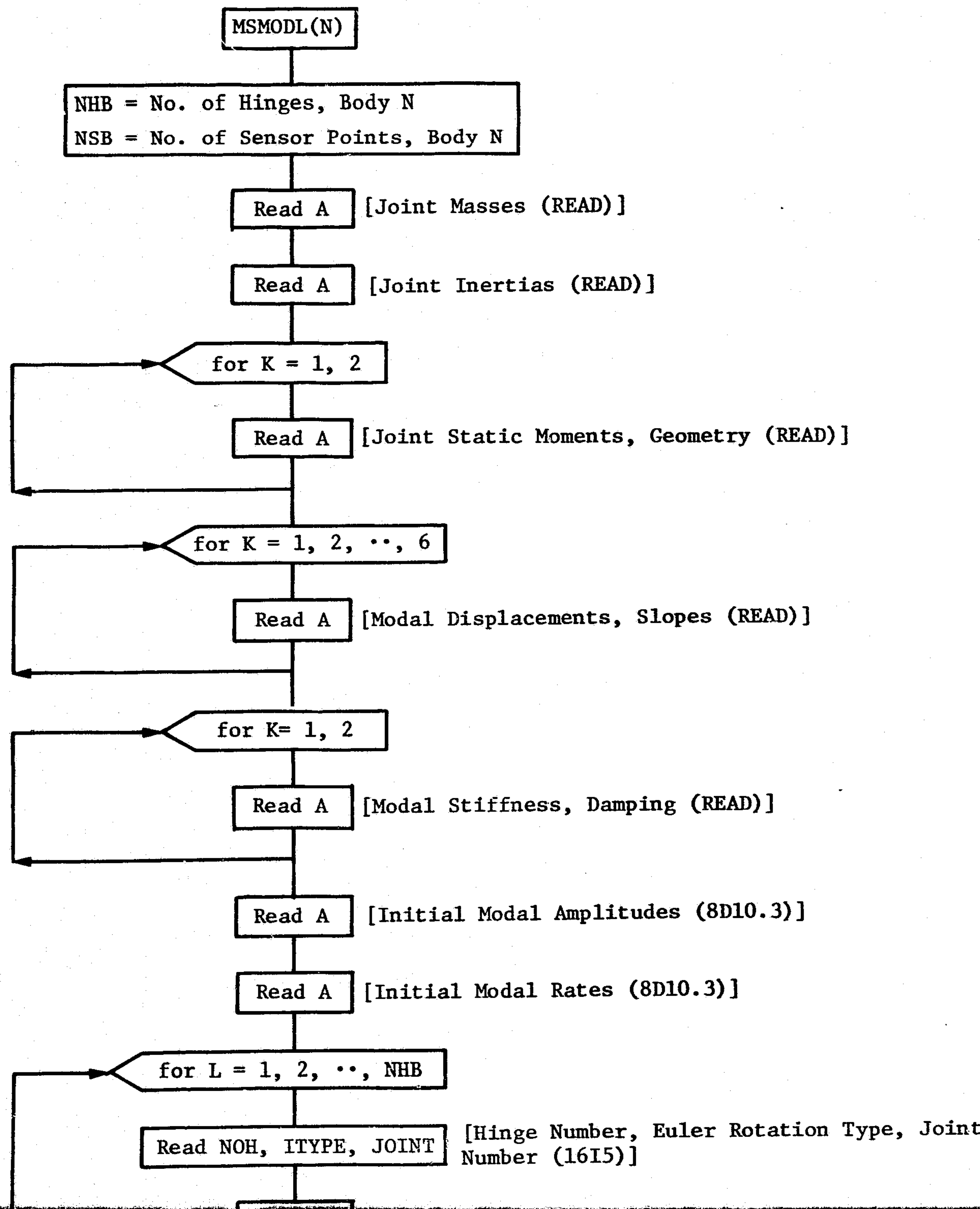


Figure
Program

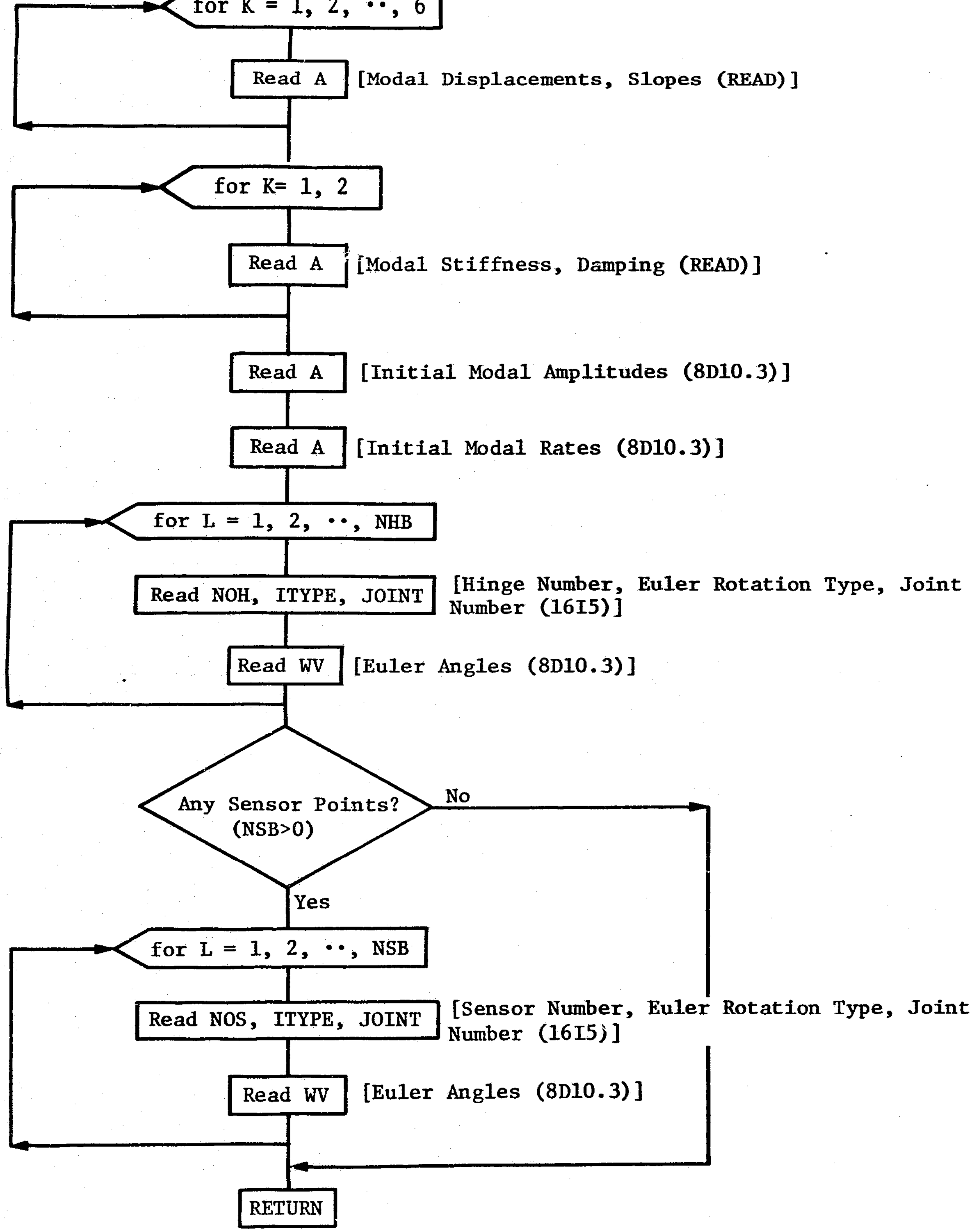
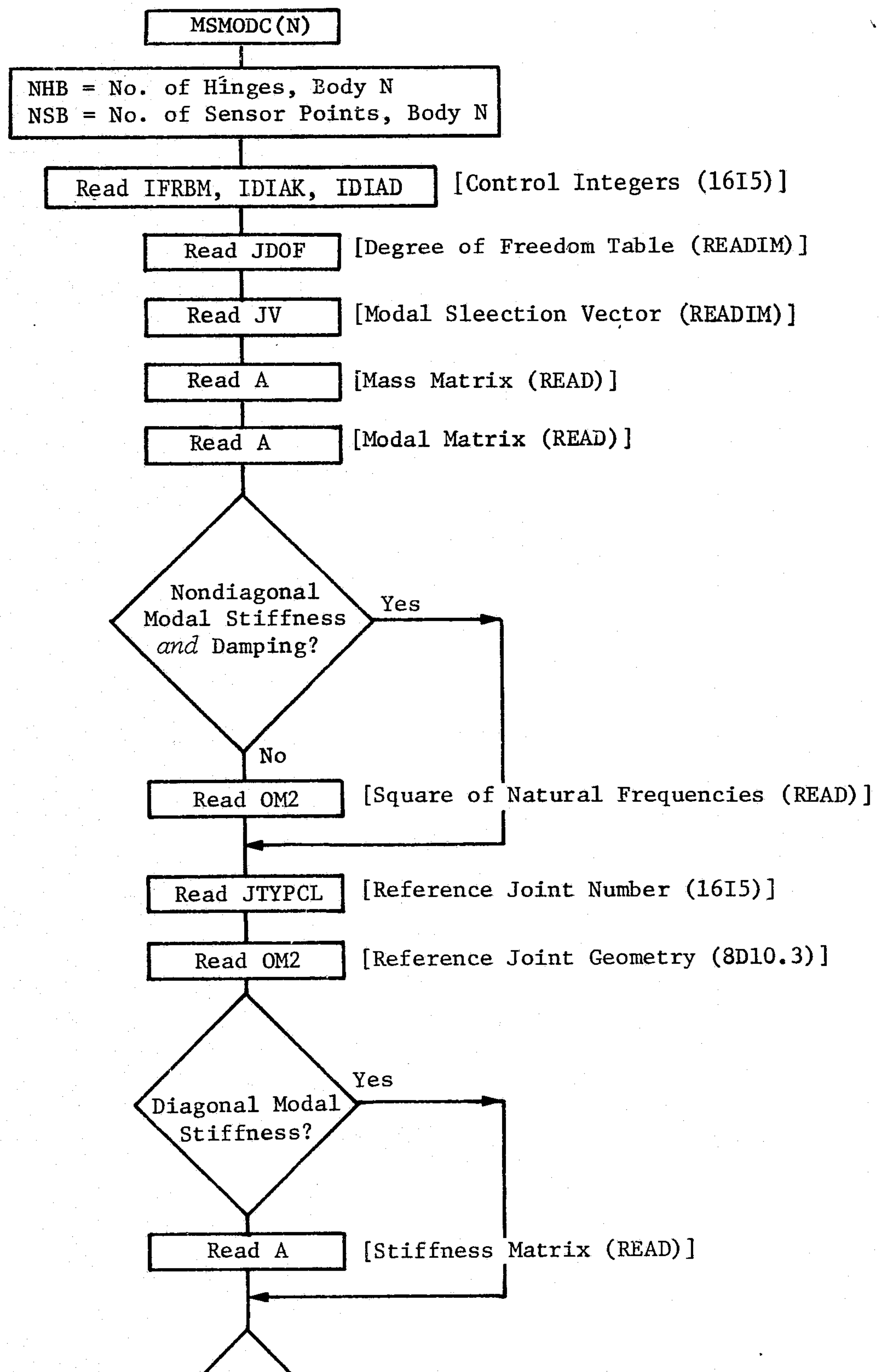


Figure IV.B-1
Program System DYNAMO Data Stream Flow (Sheet 5 of 9)


MSMODC(N)
NHB = No. of Hinges, Body N
NSB = No. of Sensor Points, Body N
Read IFRBM, IDIAK, IDIAD
[Control Integers (16I5)]
Read JDOF
[Degree of Freedom Table (READIM)]
Read JV
[Modal Sleection Vector (READIM)]
Read A
[Mass Matrix (READ)]
Read A
[Modal Matrix (READ)]
Nondiagonal Modal Stiffness *and* Damping?
Yes
No
Read OM2
[Square of Natural Frequencies (READ)]
Read JTYPCL
[Reference Joint Number (16I5)]
Read OM2
[Reference Joint Geometry (8D10.3)]
Diagonal Modal Stiffness?
Yes
Read A
[Stiffness Matrix (READ)]

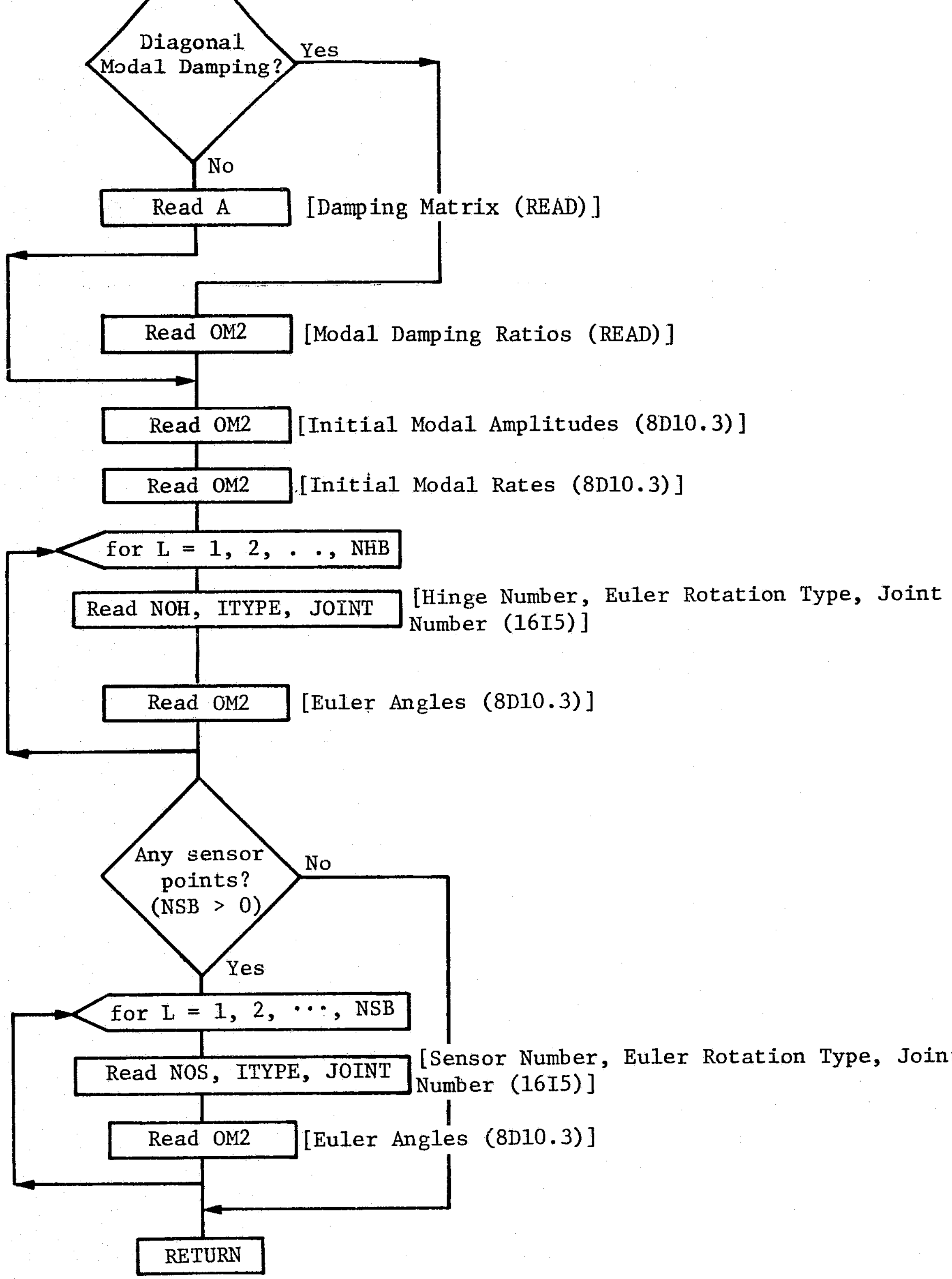
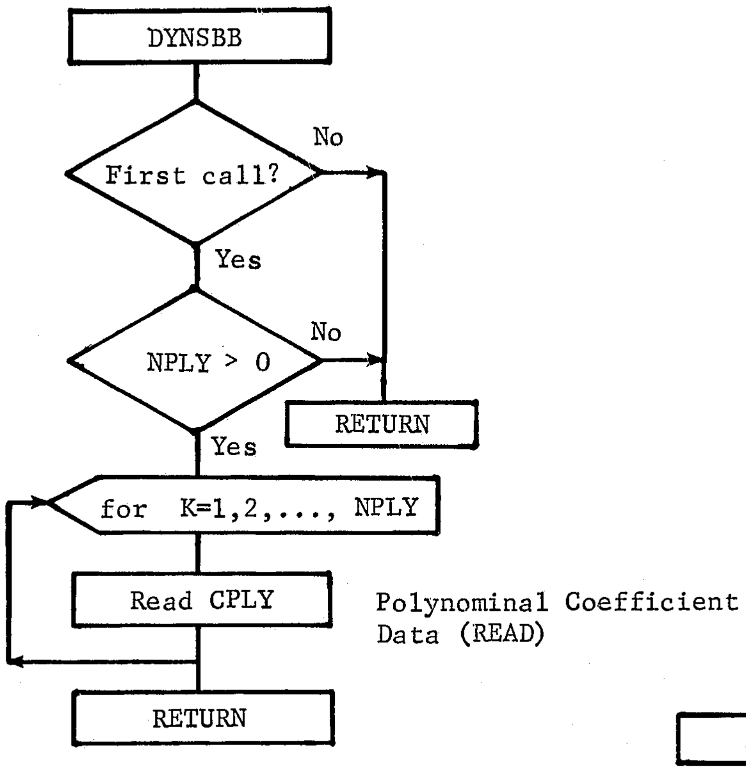


Figure IV.B-1
Program System DYNAMO Data Stream Flow (Sheet 6 of 9)

FOLDOUT FRAME 2



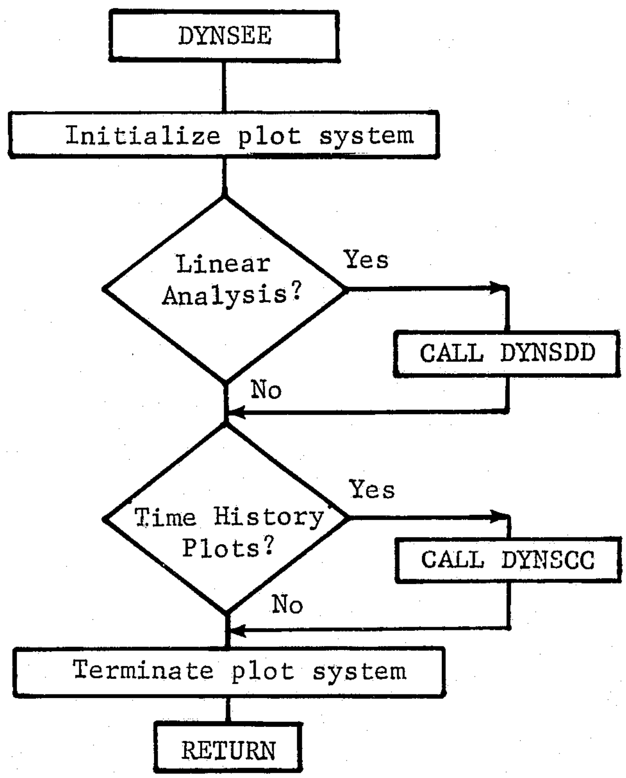


Figure IV.B-1

Program System DYNAMO Data Stream Flow (Sheet 7 of 9)

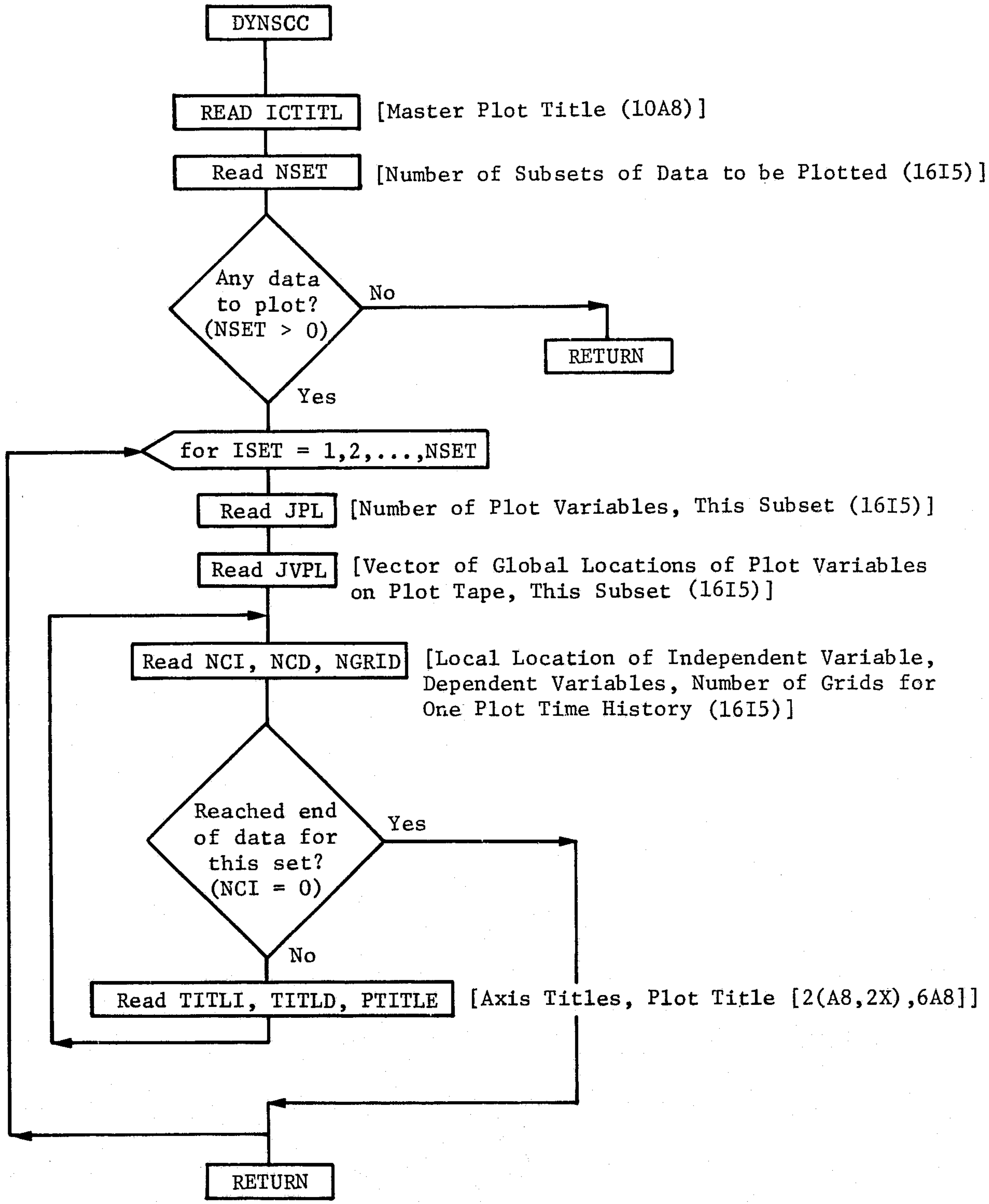
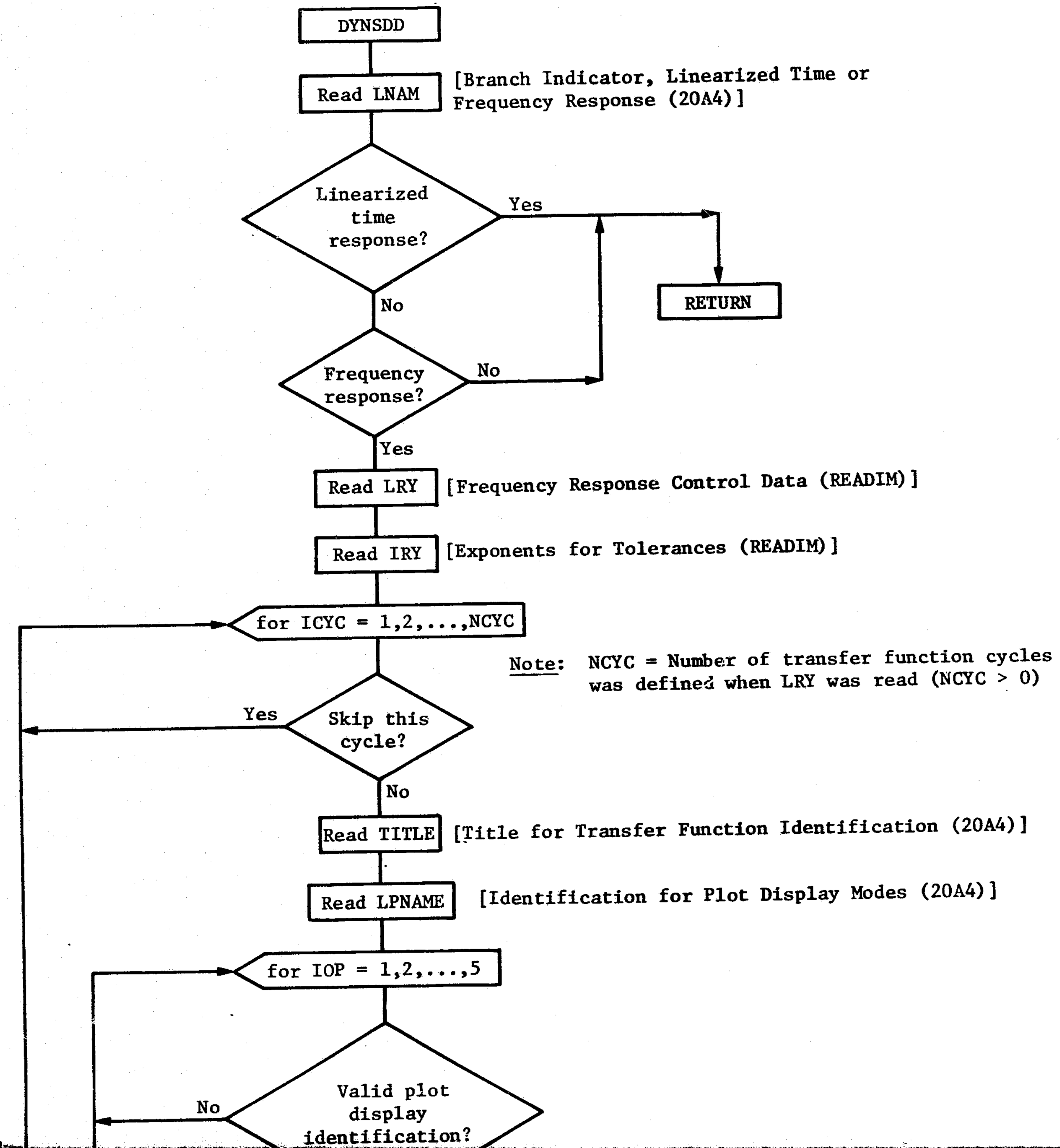


Figure IV.B-1
Program System DYNAMO Data Stream Flow (Sheet 8 of 9)


DYNSDD
Read LNAM
[Branch Indicator, Linearized Time or Frequency Response (20A4)]
Linearized time response?
Yes
RETURN
No
Frequency response?
No
Yes
Read LRY
[Frequency Response Control Data (READIM)]
Read IRY
[Exponents for Tolerances (READIM)]
for ICYC = 1,2,...,NCYC
Note: NCYC = Number of transfer function cycles was defined when LRY was read (NCYC > 0)
Yes
Skip this cycle?
No
Read TITLE
[Title for Transfer Function Identification (20A4)]
Read LPNAME
[Identification for Plot Display Modes (20A4)]
for IOP = 1,2,...,5
No
Valid plot display identification?

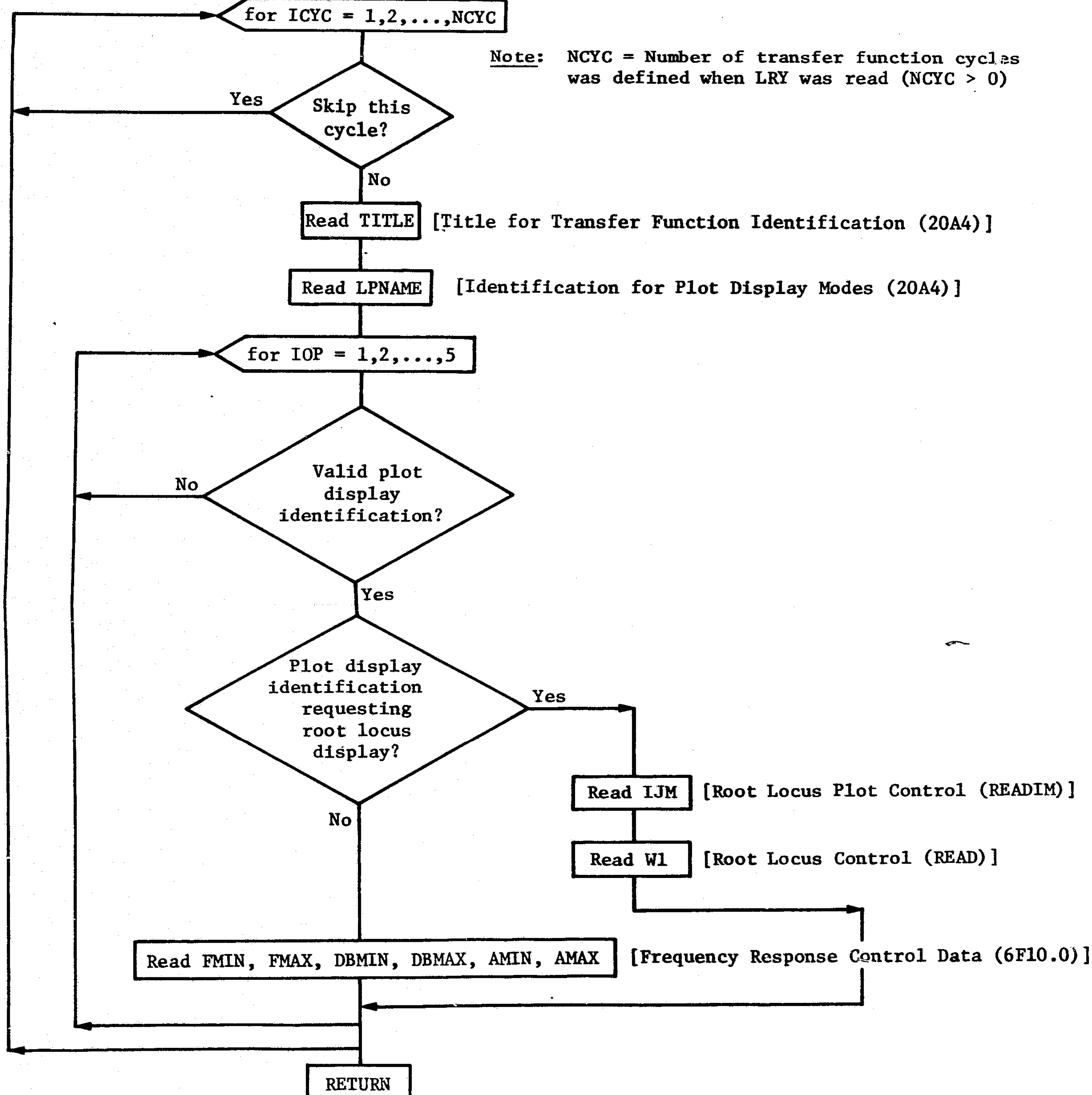


Figure IV.B-1
Program System DYNAMO Data Stream Flow (Sheet 9 of 9)

FOLDOUT FRAME 2

```
C
C
C
C
C
C
C
C
C         *****  DYNAMO PROGRAM DATA STREAM  *****
C
C                        ***************
C
C
C*****************************************************************************
C*
C* MAIN PROGRAM
C*
C*****************************************************************************
C
C          NIT = INPUT TAPE NUMBER
C
C-------------------- DENOTES WHERE DATA
C-------------------- IS READ INTO PROGRAM
C
C
C-----999 CALL START
C
C---------CALL COMENT
C
C---------CALL DYNSAA
C
C---------CALL DYNSBB
C
C         CALL DYNSEE
C
C                  IFLNER = LINEARIZATION FLAG = IPDATA(3)
C                  NOPLOT = PLOT CONTROL FLAG  = IPDATA(2)
C
C---------IF (IFLNER .EQ. 1) CALL DYNSDD
C
C---------IF (NOPLOT .GT. 0) CALL DYNSCC
C
C         GO TO 999
C
C         END
```

```
C
C
C
C
C
C***********************************************************************
C*
C* SUBROUTINE START  - INPUT IDENTIFICATIONS
C*
C***********************************************************************
C
C
C---------READ(NIT,FORMAT = A6,4X,3A6) IRUNNO, (UNAME(I),I=1,3)
C
C                     IRUNNO = RUN IDENTIFICATION NUMBER (6 CHARACTERS)
C                     UNAME  = USERS NAME (18 CHARACTERS)
C
C                     IRUNNO EQ 4HSTOP - TERMINATE THE RUN
C                     IRUNNO NE 4HSTOP - CONTINUE THE RUN
C
C
C---------READ(NIT,FORMAT = 12A6) (TITLE1(I),I=1,12)
C---------READ(NIT,FORMAT = 12A6) (TITLE2(I),I=1,12)
C
C                     TITLE1 = 72 CHARACTER USER SUPPLIED TITLE
C                     TITLE2 = 72 CHARACTER USER SUPPLIED TITLE
C
C          RETURN
C          END
```

```
C
C
C
C
C
C*********************************************************************
C*
C* SUBROUTINE COMENT - INPUT USER SUPPLIED COMMENTS
C*
C*********************************************************************
C
C
C---------READ(NIT,FORMAT = 13A6,1X,A1) (IREMRK(I),I=1,13), IPGHD
C
C                 IREMRK = 78 CHARACTER USER SUPPLIED COMMENT
C                 IPGHD  = NEW PAGE FLAG
C
C                      IPGHD = 1HP -- NEW PAGE BEFORE PRINTING
C                      THERE IS NO LIMIT TO THE NUMBER OF COMMENT CARDS BUT
C                      LAST COMMENT CARD MUST CONTAIN ZERO IN
C                      COLUMNS 1 THRU 10
C
C         RETURN
C         END
```

```
C
C
C
C
C
C**********************************************************************
C*
C* SUBROUTINE DYNSAA - INPUT PRIMARY DATA
C*
C**********************************************************************
C
C
C---------READ(NIT,FORMAT = 5I5) NB, NH, NSPT, NOFMO, NDELTA
C
C                NB     = NUMBER OF BODIES
C                NH     = NUMBER OF HINGES
C                NSPT   = NUMBER OF SENSOR POINTS
C                NOFMO  = NUMBER OF MOMENTUM WHEELS
C                NDELTA = NUMBER OF ADDITIONAL DIFFERENTIAL EQS
C                         REQUIRED - CONTAINS CONTROL SYSTEM
C                         VARIABLES
C
C
C---------CALL READIM (ITOPOL, 2, NH, 2, NHMAX)
C
C                 MATRIX SIZE 2 BY NH TO DESCRIBE TOPOLOGY
C
C                 FOR THE JTH HINGE -
C
C                 ITOPOL(1,J) = BODY N
C                 ITOPOL(2,J) = BODY M
C                   BODY N CONNECTED TO BODY M AT HINGE J
C                       ITOPOL(1,1) = 1 BY DEFINITION (BODY 1)
C                       ITOPOL(2,1) = 0 BY DEFINITION (INERTIAL REF)
C
C
C---------CALL READIM (IRGFLX, 1, NB, 1, NBMAX)
C
C                 VECTOR SIZE 1 BY NB TO DEFINE NUMBER OF ELASTIC MODES
C
C                 FOR THE JTH BODY -
C
C                 IRGFLX(J) = 0   - RIGID BODY
C                 IRGFLX(J) = N   - FLEXIBLE BODY WITH N MODES
C
C
C---------CALL READIM (IFTSMW, 1, NSPT, 1, NSPMAX)
C
C                 VECTOR SIZE 1 BY NSPT TO DEFINE SENSOR POINT LOCATIONS
C
C                 FOR THE JTH SENSOR POINT -
C
C                 IFTSMW(J) = BODY NUMBER FOR SENSOR POINT J
C
```

```
C
C
C
C
C
C            *** SUMMARY OF EULER ROTATION TYPES ***
C
C
C                 ITYPE   PERMUTATION ORDER
C
C                   1          (1,2,3)
C
C                   2          (1,2,1)
C
C                   3          (1,3,1)
C
C                   4          (1,3,2)
C
C                   5          (2,3,1)
C
C                   6          (2,3,2)
C
C                   7          (2,1,2)
C
C                   8          (2,1,3)
C
C                   9          (3,1,2)
C
C                  10          (3,1,3)
C
C                  11          (3,2,3)
C
C                  12          (3,2,1)
C
C
C---------CALL READIM (IHDATA, 7, NH, 7, NHMAX)
C
C               MATRIX SIZE 7 BY NH TO DEFINE HINGE POINT
C               CONSTRAINT DATA
C
C               FOR THE JTH HINGE -
C
C               IHDATA(1,J) = EULER ROTATION TYPE TO ORIENT Q-TRIAD
C                             WRT TO P-TRIAD AT HINGE J (ITYPE)
C               IHDATA(2,J) = HINGE CONSTRAINT TYPE - THETA 1 ROTATION
C               IHDATA(3,J) = HINGE CONSTRAINT TYPE - THETA 2 ROTATION
C               IHDATA(4,J) = HINGE CONSTRAINT TYPE - THETA 3 ROTATION
C               IHDATA(5,J) = HINGE CONSTRAINT TYPE - X TRANSLATION
C               IHDATA(6,J) = HINGE CONSTRAINT TYPE - Y TRANSLATION
C               IHDATA(7,J) = HINGE CONSTRAINT TYPE - Z TRANSLATION
C
C                 ROTATIONS REFER TO ORDER DEFINED BY ITYPE
C
C                 TRANSLATIONS REFER TO P-TRIAD
C
C                 IHDATA(2-7,J) = 0 - NO CONSTRAINT
C                 IHDATA(2-7,J) = 1 - FIXED CONSTRAINT
C                 IHDATA(2-7,J) = 2 - RHEONOMIC CONSTRAINT
C
C
```

```
C
C
C
C
C
C                NOTE -- NUMBER OF BETA STATE VARIABLES COMPUTED FROM
C                        IHDATA AS SUM OF NUMBER OF ZEROS + SUM OF
C                        NUMBER OF TWOS IN ROWS 2 THRU 7
C
C                        NUMBER OF CONSTRAINTS COMPUTED FROM
C                        IHDATA AS SUM OF NUMBER OF ONES + SUM OF
C                        NUMBER OF TWOS IN ROWS 2 THRU 7
C
C
C---------CALL READ (BETAH, 6, NH, 6, NHMAX)
C
C                MATRIX SIZE 6 BY NH TO DEFINE INITIAL VALUES
C                OF BETA WHICH ORIENT TWO BODIES ASSOCIATED
C                WITH EACH HINGE
C
C                FOR THE JTH HINGE -
C
C                BETAH(1,J) = THETA 1 ROTATION
C                BETAH(2,J) = THETA 2 ROTATION
C                BETAH(3,J) = THETA 3 ROTATION
C                BETAH(4,J) = X TRANSLATION
C                BETAH(5,J) = Y TRANSLATION
C                BETAH(6,J) = Z TRANSLATION
C
C
C---------CALL READ (BETAHD, 6, NH, 6, NHMAX)
C
C                MATRIX SIZE 6 BY NH TO DEFINE INITIAL VALUES
C                OF BETA DOT - TIME DERIVATIVE OF BETAH
C                DESCRIBED PREVIOUSLY
C
C                FOR THE JTH HINGE -
C
C                BETAHD(1,J) = THETA 1 ROTATION RATE
C                BETAHD(2,J) = THETA 2 ROTATION RATE
C                BETAHD(3,J) = THETA 3 ROTATION RATE
C                BETAHD(4,J) = X TRANSLATION RATE
C                BETAHD(5,J) = Y TRANSLATION RATE
C                BETAHD(6,J) = Z TRANSLATION RATE
C
C
C                NOTE -- IF THE CORRESPONDING CONSTRAINT TYPE
C                        IS 1 OR 2, THE INITIAL BETAHD(1-6,J),
C                        INPUT HERE, WILL BE IGNORED AND SET TO
C                        ZERO OR TO THE RHEONOMICALLY PRESCRIBED
C                        VALUE, RESPECTIVELY
C
C
C
```

```
C
C
C
C
C
C     NOFMO = NUMBER OF MOMENTUM WHEELS
C
C           IF (NOFMO .EQ. 0) GO TO 41
C
C
C----------CALL READIM (IMO, 3, NOFMO, 3, NMWMAX)
C
C                     MATRIX SIZE 3 BY NOFMO TO DEFINE BASIC
C                     MOMENTUM WHEEL DATA
C
C                     FOR THE JTH MOMENTUM WHEEL -
C
C                     IMO(1,J) = SENSOR POINT NUMBER FOR THE WHEEL
C                     IMO(2,J) = SPIN AXIS NUMBER FOR THE WHEEL (1,2 OR 3)
C                     IMO(3,J) = 1 ACTIVE WHEEL
C                              = 0 CONSTANT SPEED WHEEL
C
C
C----------CALL READ (AMO, 2, NOFMO, 2, NMWMAX)
C
C                     MATRIX SIZE 2 BY NOFMO TO DEFINE MOMENTUM
C                     WHEEL DATA
C
C                     FOR THE JTH MOMENTUM WHEEL -
C
C                     AMO(1,J) = INITIAL WHEEL SPIN RATE
C                     AMO(2,J) = SPIN INERTIA
C
C      41 CONTINUE
C
C
C----------CALL READ (TMDATA, 1, 3, 1, 3)
C
C                     VECTOR SIZE 1 BY 3 CONTAINING TIME HISTORY
C                     INTEGRATION CONTROLS
C
C                     TMDATA(1) = INITIAL TIME      (STARTT)
C                     TMDATA(2) = TIME INTERVAL     (DELTAT)
C                     TMDATA(3) = TERMINATION TIME (ENDT   )
C
C
```

```
C
C
C
C
C
C---------READIM (IPDATA, 1, 3, 1, 3)
C
C                 VECTOR SIZE 1 BY 3 CONTAINING INTEGER
C                 CONTROL DATA
C
C                 IPDATA(1) = PRINT CONTROL FOR TIME RESPONSE - PRINT
C                             EVERY IPDATA(1) MULTIPLES OF DELTAT
C                 IPDATA(2) = PLOT CONTROL FOR TIME RESPONSE - SAVE
C                             EVERY IPDATA(2) MULTIPLES OF DELTAT
C                 IPDATA(3) = 0 PERFORM NONLINEAR TIME RESPONSE
C                           = 1 PERFORM LINEAR TIME OR FREQUENCY
C                               RESPONSE
C
C
C---------CALL READ (CNTDTA, 1, NCNPAR, 1, KCONT)
C
C                 VECTOR SIZE 1 BY NCNPAR FOR CONTROL SYSTEM VARIABLES
C                 AND USER SUPPLIED VARIABLES
C
C                 THIS IS A CATCH-ALL VECTOR FOR USER PAK DATA
C
C                 INFORMATION IS PUT INTO COMMON /CONTRL/ AND IS
C                 IDENTIFIED BY USER SUPPLIED EQUIVALENCE MAP
C                 IN USER PAK
C
C                 FIRST NDELTA ELEMENTS MUST CONTAIN INITIAL VALUES
C                 FOR DELTA VARIABLES IN STATE VECTOR
C
C                 ADDITIONAL SPACE IS AVAILABLE TO THE USER
C
C
C---------CALL READ (WV, 1, 4, 1, 5)
C
C                 VECTOR SIZE 1 BY 4 FOR GRAVITY GRADIENT DATA
C
C                 WV(1) = PROJECTION OF GRAVITY VECTOR ON X INERTIAL AXIS
C                 WV(2) = PROJECTION OF GRAVITY VECTOR ON Y INERTIAL AXIS
C                 WV(3) = PROJECTION OF GRAVITY VECTOR ON Z INERTIAL AXIS
C                 WV(4) = RADIUS VECTOR FROM GRAVITY SOURCE TO GENERAL
C                         VICINITY OF BODY CLUSTER
C
C
C                 NOTE -- IF(WV(1)**2 + WV(2)**2 + WV(3)**2)
C                                  EQ 0, WV(4) IS IGNORED
C                                  NE 0, WV(4) MUST BE GT 1
C
C                         (GRAVITY VECTOR COMPONENTS IN
C                         UNITS OF ACCELERATION)
C
```

```
C
C
C
C
C
C
C      NB = NUMBER OF BODIES
C
C          DO 20 N=1,NB
C
C                  IRGFLX(N) EQ 0 -  RIGID BODY
C                  IRGFLX(N) GT 0 -  FLEXIBLE BODY
C
C          IF (IRGFLX(N) .EQ. 0) GO TO 25
C
C----------READ(NIT,FORMAT = I5) NTYPE
C
C                  NTYPE = 1 - LUMPED MASS REPRESENTATION
C                  NTYPE = 2 - CONSISTENT MASS REPRESENTATION
C
C          IF (NTYPE .EQ. 1) CALL MSMODL(N)     --- SEE FOLLOWING
C
C          IF (NTYPE .EQ. 2) CALL MSMODC(N)     --- SEE FOLLOWING
C
C          GO TO 20
C
C       25 CALL MRIGID(N)    --- SEE FOLLOWING
C
C       20 CONTINUE
C
C          RETURN
C          END
```

```
C
C
C
C
C
C*******************************************************************************
C*
C* SUBROUTINE MRIGID - INPUT FOR RIGID BODY
C*
C*******************************************************************************
C
C
C---------CALL READ (V, 1, 4, 1, 6)
C
C                 VECTOR SIZE 1 BY 4
C
C                 V(1) = MASS OF BODY
C                 V(2) = X (BODY REF POINT TO BODY CG, BODY TRIAD)
C                 V(3) = Y (BODY REF POINT TO BODY CG, BODY TRIAD)
C                 V(4) = Z (BODY REF POINT TO BODY CG, BODY TRIAD)
C
C
C---------CALL READ (V, 1, 6, 1, 6)
C
C                 VECTOR SIZE 1 BY 6
C
C                 V(1) = JXX
C                 V(2) = JYY
C                 V(3) = JZZ (BODY REFERENCED INERTIAS - BODY TRIAD)
C                 V(4) = JXY      (INERTIAS ABOUT REF POINT, NOT BODY CG)
C                 V(5) = JXZ
C                 V(6) = JYZ
```

$$\text{NOTE --}\quad J_{xx} = \int_{vol} (y^2 + z^2)\,dm, \quad Jxy = \int_{vol} (xy)\,dm, \text{ etc}$$

```
C
C         NHB = NUMBER OF HINGES ON BODY N - EXCLUSIVE OF HINGE 1, BODY 1
C
C         DO 10 I=1,NHB
C
C
C---------READ(NIT,FORMAT = 2I5) NOH, ITYPE
C
C                 NOH   = HINGE NUMBER
C                 ITYPE = EULER ROTATION TYPE TO ORIENT HINGE
C                         TRIAD WRT BODY TRIAD
C
C
```

```
C
C
C
C
C
C---------READ(NIT,FORMAT = 3D10.3) (V(J),J=1,3)
C
C                   EULER ANGLES TO ORIENT HINGE TRIAD - PERMUTATION
C                   ORDER DEFINED BY ITYPE
C
C                   V(1) = THETA 1 (FIRST ROTATION)
C                   V(2) = THETA 2 (SECND ROTATION)
C                   V(3) = THETA 3 (THIRD ROTATION)
C
C
C---------READ(NIT,FORMAT = 3D10.3) (DH(J),J=1,3)
C
C                   VECTOR TO POSITION HINGE TRIAD WRT BODY TRIAD
C
C                   DH(1) = X (BODY REF POINT TO HINGE POINT, BODY TRIAD)
C                   DH(2) = Y (BODY REF POINT TO HINGE POINT, BODY TRIAD)
C                   DH(3) = Z (BODY REF POINT TO HINGE POINT, BODY TRIAD)
C
C        10 CONTINUE
C
C           NSB = NUMBER OF SENSOR POINTS ON BODY N
C
C           IF (NSB .EQ. 0) RETURN
C
C           DO 20 I=1,NSB
C
C
C---------READ(NIT,FORMAT = 2I5) NOS, ITYPE
C
C                   NOS   = SENSOR POINT NUMBER
C                   ITYPE = EULER ROTATION TYPE TO ORIENT SENSOR POINT
C                           TRIAD WRT BODY TRIAD
C
C
C---------READ(NIT,FORMAT = 3D10.3) (V(J),J=1,3)
C
C                   EULER ANGLES TO ORIENT SENSOR POINT TRIAD - PERMUTATION
C                   ORDER DEFINED BY ITYPE
C
C                   V(1) = THETA 1 (FIRST ROTATION)
C                   V(2) = THETA 2 (SECND ROTATION)
C                   V(3) = THETA 3 (THIRD ROTATION)
C
C
```

```
C
C
C
C
C
C
C---------READ(NIT,FORMAT = 3D10.3) (DS(J),J=1,3)
C
C                     VECTOR TO POSITION SENSOR POINT TRIAD WRT BODY TRIAD
C
C                     DH(1) = X (BODY REF POINT TO SENSOR POINT, BODY TRIAD)
C                     DH(2) = Y (BODY REF POINT TO SENSOR POINT, BODY TRIAD)
C                     DH(3) = Z (BODY REF POINT TO SENSOR POINT, BODY TRIAD)
C
C      20 CONTINUE
C
C         RETURN
C         END
```

```
C
C
C
C
C
C*****************************************************************
C*
C* SUBROUTINE MSMODL - INPUT FOR FLEXIBLE BODY, LUMPED MASS MATRIX
C*
C*****************************************************************
C
C
C---------CALL READ (A, NJ, 1, KJOINT, KMODE)
C
C                 MATRIX SIZE NJ BY 1 WHERE NJ = NUMBER OF JOINTS
C                 ON BODY N
C
C                 FOR THE ITH JOINT -
C
C                 A(I,1) = JOINT MASS
C
C
C---------CALL READ (A, NJ, 6, KJOINT, KMODE)
C
C                 MATRIX SIZE NJ BY 6
C
C                 FOR THE ITH JOINT -
C
C                 A(I,1) = JOINT INERTIA, JXX
C                 A(I,2) = JOINT INERTIA, JYY
C                 A(I,3) = JOINT INERTIA, JZZ
C                 A(I,4) = JOINT INERTIA, JXY
C                 A(I,5) = JOINT INERTIA, JXZ
C                 A(I,6) = JOINT INERTIA, JYZ
C
C                 NOTE --
```

$$J_{xx} = \int_{vol} (y^2 + z^2)dm, \quad J_{xy} = \int_{vol} (xy)dm, \text{ etc}$$

```
C
C
C        DO 5 K=1,2
C
C
C---------CALL READ (A, NJ, 3, KJOINT, KMODE)
C
C                 MATRIX SIZE NJ BY 3
C
C                 FOR THE ITH JOINT -
C
C             K=1  A(I,1) = JOINT STATIC MASS MOMENT, SX
C                  A(I,2) = JOINT STATIC MASS MOMENT, SY
C                  A(I,3) = JOINT STATIC MASS MOMENT, SZ
C
C             K=2  A(I,1) = X (BODY REF POINT TO JOINT, BODY TRIAD)
C                  A(I,2) = Y (BODY REF POINT TO JOINT, BODY TRIAD)
C                  A(I,3) = Z (BODY REF POINT TO JOINT, BODY TRIAD)
C
C       5 CONTINUE
C
C
C
```

```
C
C
C
C
C
C          DO 10 K=1,6
C
C
C---------CALL READ (A, NJ, NE, KJOINT, KMODE)
C
C                   MATRIX SIZE NJ BY NE WHERE NE = NUMBER OF ELASTIC
C                   MODES RETAINED FOR BODY N
C
C                   FOR THE ITH JOINT -
C
C              K=1  A(I,J) = X DISPLACEMENT AT JOINT, MODE J
C              K=2  A(I,J) = Y DISPLACEMENT AT JOINT, MODE J
C              K=3  A(I,J) = Z DISPLACEMENT AT JOINT, MODE J
C              K=4  A(I,J) = THETA X ROTATION AT JOINT, MODE J
C              K=5  A(I,J) = THETA Y ROTATION AT JOINT, MODE J
C              K=6  A(I,J) = THETA Z ROTATION AT JOINT, MODE J
C
C       10 CONTINUE
C
C
C          DO 20 K=1,2
C
C
C---------CALL READ (A, NE, NE, KJOINT, KMODE)
C
C                   MATRIX SIZE NE BY NE
C
C              K=1  A = MODAL STIFFNESS
C
C              K=2  A = MODAL DAMPING
C
C       20 CONTINUE
C
C
C---------READ(NIT,FORMAT = 8D10.3) (A(J),J=1,NE)
C
C                   VECTOR OF INITIAL MODAL DEFLECTION COORDINATES
C
C---------READ(NIT,FORMAT = 8D10.3) (A(J),J=1,NE)
C
C                   VECTOR OF INITIAL MODAL VELOCITY COORDINATES
C
C
C
```

```
C
C
C
C
C
C                    NOTE -- FOLLOWING EULER ANGLES MEASURED
C                            IN UNDEFORMED CONFIGURATION
C
C
C            NHB = NUMBER OF HINGES ON BODY N - EXCLUSIVE OF HINGE 1, BODY 1
C
C            DO 150 L=1,NHB
C
C
C---------READ(NIT,FORMAT = 3I5) NOH, ITYPE, JOINT
C
C                   NOH   = HINGE NUMBER
C                   ITYPE = EULER ROTATION TYPE TO ORIENT HINGE
C                           TRIAD WRT BODY TRIAD
C                   JOINT = JOINT NUMBER CORRESPONDING TO HINGE POINT
C
C
C---------READ(NIT,FORMAT = 3D10.3) (WV(J),J=1,3)
C
C                   EULER ANGLES TO ORIENT HINGE TRIAD - PERMUTATION
C                   ORDER DEFINED BY ITYPE
C
C                   WV(1) = THETA 1 (FIRST ROTATION)
C                   WV(2) = THETA 2 (SECND ROTATION)
C                   WV(3) = THETA 3 (THIRD ROTATION)
C
C        150 CONTINUE
C
C
C            NSB = NUMBER OF SENSOR POINTS ON BODY N
C
C            IF (NSB .EQ. 0) RETURN
C
C            DO 160 L=1,NSB
C
C
C---------READ(NIT,FORMAT = 3I5) NOS, ITYPE, JOINT
C
C                   NOS   = SENSOR POINT NUMBER
C                   ITYPE = EULER ROTATION TYPE TO ORIENT SENSOR POINT
C                           TRIAD WRT BODY TRIAD
C                   JOINT = JOINT NUMBER CORRESPONDING TO SENSOR POINT
C
C
C
```

```
C
C
C
C
C
C---------READ(NIT,FORMAT = 3D10.3) (WV(J),J=1,3)
C
C                EULER ANGLES TO ORIENT SENSOR POINT TRIAD - PERMUTATION
C                ORDER DEFINED BY ITYPE
C
C                WV(1) = THETA 1 (FIRST ROTATION)
C                WV(2) = THETA 2 (SECND ROTATION)
C                WV(3) = THETA 3 (THIRD ROTATION)
C
C     160 CONTINUE
C
C         RETURN
C         END
```

```
C
C
C
C
C
C*************************************************************************
C*
C* SUBROUTINE MSMODC - INPUT FOR FLEXIBLE BODY, CONSISTENT MASS MATRIX
C*
C*************************************************************************
C
C
C---------READ(NIT,FORMAT = 3I5) IFRBM, IDIAK, IDIAD
C
C                  IFRBM = RIGID BODY MODE CONTROL VARIABLE
C
C                        = 0  WHEN RIGID BODY MODES CAN BE
C                             OPERATED ON VIA ROW-COL
C                             INTERCHANGES TO OBTAIN A RIGID
C                             BODY MODAL MATRIX OF THE FORM-
C
C                    **   **    **                       ** **    **
C                    * HX *     * 1  0  0  0  Z -Y *  * QX  *
C                    *    *     *                  *  *     *
C                    * HY *     * 0  1  0 -Z  0  X *  * QY  *
C                    *    *     *                  *  *     *
C                    * HZ *     * 0  0  1  Y -X  0 *  * QZ  *
C                    *    *  =  *                  *  *     *
C                    * TX *     * 0  0  0  1  0  0 *  * QTX *
C                    *    *     *                  *  *     *
C                    * TY *     * 0  0  0  0  1  0 *  * QTY *
C                    *    *     *                  *  *     *
C                    * TZ *     * 0  0  0  0  0  1 *  * QTZ *
C                    **   **    **                       ** **    **
C
C
C
C                        = 1  WHEN ABOVE IS NOT TRUE, SUCH
C                             AS FOR AN ORTHONORMAL SET OF
C                             RIGID BODY  VECTORS. DATA WILL
C                             BE READ IN LATER AND THE ABOVE
C                             FORM WILL BE CREATED WITHIN
C                             THIS SUBROUTINE
C
C
```

```
C
C
C
C
C
C                       IDIAK = 0  IF MODAL STIFFNESS MATRIX
C                                  IS NOT DIAGONAL
C
C                             = 1  IF MODAL STIFFNESS MATRIX
C                                  IS DIAGONAL
C
C
C                       IDIAD = 0  IF MODAL DAMPING MATRIX
C                                  IS NOT DIAGONAL
C
C                             = 1  IF MODAL DAMPING MATRIX
C                                  IS DIAGONAL
C
C
C---------CALL READIM (JDOF, NX, N6, KJDOF, 6)
C
C                 MATRIX SIZE NX BY 6 DEFINING JOINT DEGREES
C                 OF FREEDOM FOR NX JOINTS ON BODY N
C
C                 FOR THE ITH JOINT -
C
C                  JDOF(I,1) = X DEG. OF FREEDOM FOR POINT I.
C                  JDOF(I,2) = Y DEG. OF FREEDOM FOR POINT I.
C                  JDOF(I,3) = Z DEG. OF FREEDOM FOR POINT I.
C                  JDOF(I,4) =TX DEG. OF FREEDOM FOR POINT I.
C                  JDOF(I,5) =TY DEG. OF FREEDOM FOR POINT I.
C                  JDOF(I,6) =TZ DEG. OF FREEDOM FOR POINT I.
C
C                           POINT I IS CONSISTANT WITH THE
C                           MODAL MATRIX ROW I, BEFORE REORDING.
C
C                           JDOF WILL BE INTERROGATED AND THE
C                           COORDINATES WILL BE ORDERED AS --
C
C                             HX(I) FOR JOINTS 1 THRU NX
C                             HY(I) FOR JOINTS 1 THRU NX
C                             HZ(I) FOR JOINTS 1 THRU NX
C                             TX(I) FOR JOINTS 1 THRU NX
C                             TY(I) FOR JOINTS 1 THRU NX
C                             TZ(I) FOR JOINTS 1 THRU NX
C
C
```

```
C
C
C
C
C
C---------CALL READIM (JV, 1, NMODT, 1, KAB)
C
C               VECTOR SIZE 1 BY NMODT = NUMBER OF RIGID BODY MODES +
C                                        NUMBER OF ELASTIC MODES
C
C               JV(J) = IND    WHERE IND IS COLUMN NO. WHICH COL(J) OF ORIG
C                              MODAL MATRIX WILL APPEAR IN
C                              REVISED MODE MATRIX
C                     IND GT 0   REPLACE COLUMN
C                     IND EQ 0   DELETE COLUMN
C                     IND LT 0   REPLACE COLUMN, CHANGE SIGNS
C
C
C---------CALL READ (A, NRA, NCA, KAB, KAB)
C
C               MATRIX SIZE 6*NX BY 6*NX CONTAINS CONSISTENT
C               MASS REPRESENTATION
C
C               ROW-COLUMN COORDINATE ORDER MUST BE CONSISTENT
C               WITH THE DEGREE OF FREEDOM TABLE, JDOF
C
C
C---------CALL READ (A, NRA, NMODT, KAB, KAB)
C
C               MATRIX SIZE 6*NX BY NMODT CONTAINS MODAL DEFINITION
C
C               THE COLUMNS (MODE ORDER) WILL BE REORDERED BY
C               THE INPUT VECTOR JV
C
C
C          IF (IDIAK .EQ. 0  .AND.  IDIAD .EQ. 0) GO TO 11
C
C---------CALL READ (OM2, 1, NMODT, 1, KAB)
C
C               VECTOR SIZE 1 BY NMODT CONTAINING SQUARES OF NATURAL
C               FREQUENCIES
C
C               OM2(J) = SQUARE OF JTH NATURAL FREQUENCY CORRESPONDING
C               TO JTH INPUT MODE SHAPE
C
C      11 CONTINUE
C
C
```

```
C
C
C
C
C
C          IF (IFRBM .EQ. 0) GO TO 5
C
C
C---------READ(NIT,FORMAT = I5) JTYPCL
C
C                   JTYPCL = REFERENCE JOINT NUMBER WHOSE GEOMETRIC
C                            POSITION COORDINATES WILL BE USED TO
C                            ESTABLISH RIGID BODY MODAL MATRIX
C
C---------READ(NIT,FORMAT = 3D10.3) (OM2(J),J=1,3)
C
C                   OM2(1) = X COMPONENT OF VECTOR THAT LOCATES JTYPCL PT
C                   OM2(2) = Y COMPONENT OF VECTOR THAT LOCATES JTYPCL PT
C                   OM2(3) = Z COMPONENT OF VECTOR THAT LOCATES JTYPCL PT
C
C                   VECTOR COMPONENTS REFERED TO BODY TRIAD
C
C        5 CONTINUE
C
C
C          IF (IDIAK .EQ. 1) GO TO 50
C
C---------CALL READ (A, NRA, NCA, KAB, KAB)
C
C                   STIFFNESS MATRIX -- SEE NOTE BELOW
C
C       50 CONTINUE
C
C          IF (IDIAD .EQ. 1) GO TO 60
C
C
C---------CALL READ (A, NRA, NCA, KAB, KAB)
C
C                   DAMPING MATRIX -- SEE NOTE BELOW
C
C          GO TO 61
C
C       60 CONTINUE
C
C
C---------READ(NIT,FORMAT = 8D10.3) (OM2(J),J=1,NE)
C
C                   VECTOR SIZE 1 BY NE = NUMBER OF ELASTIC MODES
C                   RETAINED VIA INPUT JV SELECTION VECTOR
C
C                   OM2(J) = MODAL DAMPING RATIO FOR JTH ELASTIC MODE
C
C       61 CONTINUE
C
C
```

```
C
C
C
C
C
C               NOTE FOR STIFFNESS AND DAMPING MATRICES
C
C                  COORDINATE ORDER ASSUMED CONSISTENT WITH
C                       THE REORDERED COORDINATE DESCRIPTION
C                       AFTER THE DEGREE OF FREEDOM TABLE (JDOF)
C                       HAS BEEN INTERROGATED AND THE FOLLOWING
C                       ORDER ESTABLISHED
C
C
C                             HX(I),I=1,2,....,N
C                              .
C                              .
C                             HY(I),I=1,2,....,N
C                              .
C                              .
C                             HZ(I),I=1,2,....,N
C                              .
C                              .
C                             TX(I),I=1,2,....,N
C                              .
C                              .
C                             TY(I),I=1,2,....,N
C                              .
C                              .
C                             TZ(I),I=1,2,....,N
C                              .
C                              .
C
C
C---------READ(NIT,FORMAT = 8D10.3)  (OM2(J),J=1,NE)
C
C               VECTOR SIZE 1 BY NE CONTAINING INITIAL
C               MODAL DEFLECTION COORDINATES
C
C
C---------READ(NIT,FORMAT = 8D10.3)  (OM2(J),J=1,NE)
C
C               VECTOR SIZE 1 BY NE CONTAINING INITIAL
C               MODAL VELOCITY COORDINATES
C
C
```

```
C
C
C
C
C
C                   NOTE -- FOLLOWING EULER ANGLES MEASURED
C                           IN UNDEFORMED CONFIGURATION
C
C
C         NHB = NUMBER OF HINGES ON BODY N - EXCLUSIVE OF HINGE 1, BODY 1
C
C         DO 110 L=1,NHB
C
C
C---------READ(NIT,FORMAT = 3I5) NOH, ITYPE, JOINT
C
C                   NOH   = HINGE NUMBER
C                   ITYPE = EULER ROTATION TYPE TO ORIENT HINGE
C                           TRIAD WRT BODY TRIAD
C                   JOINT = JOINT NUMBER CORRESPONDING TO HINGE POINT
C
C
C---------READ(NIT,FORMAT = 3D10.3) (OM2(J),J=1,3)
C
C                   EULER ANGLES TO ORIENT HINGE TRIAD - PERMUTATION
C                   ORDER DEFINED BY ITYPE
C
C                   OM2(1) = THETA 1 (FIRST ROTATION)
C                   OM2(2) = THETA 2 (SECND ROTATION)
C                   OM2(3) = THETA 3 (THIRD ROTATION)
C
C     110 CONTINUE
C
C
C         NSB = NUMBER OF SENSOR POINTS ON BODY N
C
C         IF (NSB .EQ. 0) RETURN
C
C         DO 120 L=1,NSB
C
C
C---------READ(NIT,FORMAT = 3I5) NOS, ITYPE, JOINT
C
C                   NOS   = SENSOR POINT NUMBER
C                   ITYPE = EULER ROTATION TYPE TO ORIENT SENSOR POINT
C                           TRIAD WRT BODY TRIAD
C                   JOINT = JOINT NUMBER CORRESPONDING TO SENSOR POINT
C
C
```

```
C
C
C
C
C
C
C
C---------READ(NIT,FORMAT = 3D10.3) (OM2(J),J=1,3)
C
C                   EULER ANGLES TO ORIENT SENSOR POINT TRIAD - PERMUTATION
C                   ORDER DEFINED BY ITYPE
C
C                   OM2(1) = THETA 1 (FIRST ROTATION)
C                   OM2(2) = THETA 2 (SECND ROTATION)
C                   OM2(3) = THETA 3 (THIRD ROTATION)
C
C      120 CONTINUE
C
C          RETURN
C          END
```

```
C
C
C
C
C
C*********************************************************************
C*
C* SUBROUTINE DYNSBB - INPUT USER PAK DATA (IF ANY)
C*
C*********************************************************************
C
C
C                  THE ONLY DATA READ HERE ARE THOSE ASSOCIATED
C                  WITH POLYNOMIAL DEFINITION OF TRANSFER
C                  FUNCTIONS
C
C                  DATA (IF ANY) IS READ ON THE FIRST CALL TO
C                  SUBROUTINE CONTRL WHERE THE INTEGER VARIABLE
C                  NPLY IS DEFINED BY A USER SUPPLIED DATA
C                  STATEMENT
C
C                  NPLY = NUMBER OF SETS OF POLYNOMIAL TRANSFER
C                         FUNCTION COEFFICIENTS TO READ
C
C           IF (NPLY .EQ. 0) GO TO 10
C
C           DO 20 K=1,NPLY
C
C           K2 = 2*K-1
C
C
C----------CALL READ (CPLY(1,K2), KPLY(K), 2, KRY, KCY)
C
C        20 CONTINUE
C
C                  MATRIX SIZE KPLY(K) BY 2 OF POLYNOMIAL COEFFICIENTS
C
C                  CPLY(I,1) = DENOMINATOR COEFFICIENTS IN
C                              ASCENDING ORDER
C                  CPLY(I,2) = NUMERATOR COEFFICIENTS IN
C                              ASCENDING ORDER
C
C                  NOTE -- KPLY(K) IS DEFINED AT INPUT (SUBROUTINE READ)
C                          AND IS ONE GREATER THAN THE ORDER OF THE
C                          DENOMINATOR POLYNOMIAL
C
C                          ORDER OF NUMERATOR POLYNOMIAL MUST NOT EXCEED
C                          ORDER OF DEMONINATOR POLYNOMIAL
C
C        10 CONTINUE
C
C           RETURN
C           END
```

```
C
C
C
C
C
C*****************************************************************************
C*
C* SUBROUTINE DYNSCC - INPUT FOR TIME HISTORY PLOT OUTPUT
C*
C*****************************************************************************
C
C
C---------READ(NIT,FORMAT = 10A8) (ICTITL(I),I=1,10)
C
C                 80 CHARACTER MASTER PLOT TITLE WILL APPEAR
C                 ON ALL FRAMES
C
C
C---------READ(NIT,FORMAT = I5) NSET
C
C                                NSET = NO. OF PLOT SETS TO BE
C                                       CYCLED THROUGH. EACH SET
C                                       IS LIMITED TO 16 SEPARATE
C                                       VARIABLES TO BE SELECTED
C                                       FROM THE SET OF VARIABLES
C                                       WRITTEN BE SUBROUTINE PLOTWR
C                                       OR LPLTWR.
C
C
C          DO 1000 ISET=1,NSET
C
C
C---------READ(NIT,FORMAT = I5) JPL
C
C                                JPL = NO, OF VARIABLES TO BE
C                                      SELECTED FROM THE NCPLOT
C                                      VARIABLES PREVIOUSLY WRITTEN
C                                      ON NTAPE3 FOR PLOTTING.
C                                     (JPL .LE. 16) FOR A SET
C
C                                NCPLOT = 1+2*NEQ+NLAM +NU+JR+3+3+2*NB+5
C                                           (NONLINEAR ANALYSIS)
C
C
C                                NCPLOT = 1+2*NEQ
C                                           (LINEAR ANALYSIS)
C
C                                   WHERE ----
C
C                                     NEQ = NO. OF EQUATIONS
C                                             INTEGRATED.
C
C                                    NLAM = NO. OF LAMBDA VARIABLES
C
C                                      NU = NO. OF U VARIABLES
C
C                                      JR = 6*NB
C
C                                      NB = NO. OF BODIES.
C
C
```

```
C
C
C
C
C
C
C               NOTE ---           NB
C                                *****
C                                  *
C                     NEQ      =   *  IRGFLX(J) + NU + NBETA + NDELTA
C                                  *
C                                *****
C                                 J=1
C
C
C
C
C
C                                  NB                NOFMO
C                                *****               *****
C                                  *                   *
C                     NU       =   *  IRGFLX(J) +      *  IMO(K) + 6*NB
C                                  *                   *
C                                *****               *****
C                                 J=1                 K=1
C
C
C
C                     NBETA   = SUM OF NUMBER OF ZEROS + SUM OF
C                               NUMBER OF TWOS IN ROWS 2 THRU 7
C                               OF ARRAY IHDATA
C
C
C
C                     NLAM    = SUM OF NUMBER OF ONES + SUM OF
C                               NUMBER OF TWOS IN ROWS 2 THRU 7
C                               OF ARRAY IHDATA
C
C
C
C
```

```
C
C
C
C
C
C                                ORDER OF VARIABLES AND
C                                SIZE FOR A SINGLE RECORD
C                                (FOR A SINGLE TIME, T).
C
C
C                                 VARIABLE ID.        SIZE
C
C                  NONLINEAR        TIME                1
C                  ANALYSIS
C                                   YDOT               NEQ
C
C                                    Y                 NEQ
C
C                                  LAMBDA              NLAM
C
C                                    U                 NU
C
C                                 HX, HY, HZ,
C                                 PX, PY, PZ          6*NB
C
C                                 TOTAL ANGULAR
C                                 MOMENTUM VECTOR
C                                 COMPONENTS (X,Y,Z).   3
C                                                                INERTIAL
C                                 TOTAL LINEAR                   FRAME.
C                                 MOMENTUM VECTOR
C                                 COMPONENTS (X,Y,Z).   3
C
C                                 BODY KINETIC
C                                 ENERGIES.             NB
C
C                                 BODY POTENTIAL
C                                 ENERGIES.             NB
C
C                                 TOTAL ANGULAR MOM.,
C                                 TOTAL LINEAR MOM.,
C                                 TOTAL K.E.,
C                                 TOTAL P.E.,
C                                 TOTAL ENERGY          5
C
C
C
C                  LINEAR
C                  ANALYSIS       TIME                  1
C
C                                 YDOT                 NEQ
C                                 Y                    NEQ
C
C
```

```
C
C
C
C
C
C---------READ(NIT,FORMAT = 16I5) (JVPL(J),J=1,JPL)
C
C
C                          JVPL(J) = INTEGER DENOTING GLOBAL
C                                    LOCATION OF JTH SELECTED
C                                    VARIABLE FROM THE NCPLOT
C                                    LONG ARRAY.
C
C      20 CONTINUE
C
C
C---------READ(NIT,FORMAT = 5I5) NCI, (NCD(I),I=1,3), NGRID
C
C                          NCI = ELEMENT LOCATION (LOCAL WRT
C                                JVPL ARRAY) FOR THE INDEPEN-
C                                DENT PLOT VARIABLE.
C
C                          NCD = ELEMENT LOCATION (LOCAL WRT
C                                JVPL ARRAY) FOR UP TO 3
C                                DEPENDENT VARIABLES TO PLOT
C                                SIMULTANEOUSLY VERSES THE
C                                NCI DEPENDENT VARIABLE.
C
C                          NGRID = NO. OF PLOT FRAMES TO USE
C                                  FOR PLOTTING THE NCI-NCD
C                                  GROUP. IE, THE NO. OF FRAMES
C                                  TO USE SIDE BY SIDE TO
C                                  EXHAUST THE RANGE OF THE
C                                  INDEPENDENT VARIABLE.
C
C
C         IF (NCI .EQ. 0) GO TO 1000
C
C              THIS IS CUE TO PROCEDE TO NEXT SET
C
C              THIS OPEN ENDED LOOP PERMITS MANY SELECTIONS OF THE
C              JVPL DATA VARIABLES WITH REGARD TO INDEPENDENT AND
C              DEPENDENT VARIABLES IN ORDER TO FORM CROSS-PLOTS.
C
C
C
```

```
C
C
C
C
C
C---------READ(NIT,FORMAT = A8,2X,A8,2X,6A8) TITLI, TITLD,
C        *                                   (PTITL(I),I=1,6)
C
C                                  ALPHANUMERIC TITLING INFORMATION
C                                  TO INCLUDE ON PLOTTED OUTPUT.
C
C                                  TITLI = INDEPENDENT VARIABLE TITLE.
C
C                                  TITLD =   DEPENDENT VARIABLE TITLE.
C
C                                  PTITL =  OVERALL TITLE FOR PARTICULAR
C                                           IDENTIFICATION OF THIS FRAME.
C
C
C
C          GO TO 20
C
C     1000 CONTINUE
C
C          RETURN
C          END
```

```
C
C
C
C
C
C*****************************************************************
C*
C* SUBROUTINE DYNSDD - INPUT FOR LINEARIZED SYSTEM ANALYSES
C*
C*****************************************************************
C
C
C---------READ(NIT,FORMAT = A4) LNAM
C
C                       LNAM = 4HTIME FOR LINEARIZED
C                                TIME RESPONSE
C
C                            = 4HFREQ FOR LINEARIZED
C                                FREQUENCY DOMAIN STUDY
C
C         IF (LNAM .EQ. 4HTIME) RETURN
C
C         IF (LNAM .EQ. 4H    ) RETURN
C
C
C---------CALL READIM (LRY, 9, NCYC, 9, KR)
C
C              MATRIX SIZE  9 BY NCYC DEFINING FREQUENCY
C              ANALYSIS CONTROL DATA
C
C                   NCYC = NO. OF SEPARATE TRANSFER
C                          FUNCTION CYCLES TO CONSIDER
C                          FOR THIS SIMULATION
C
C              FOR THE JTH CYCLE -
C
C              LRY( 1,J) = ITYPE --- INTEGER CLASSIFYING THE
C                                    TRANSFER FUNCTION TYPE.
C
C                          ITYPE = 1 PLANT ONLY (G)
C                                = 2 CONTROLLER (H)
C                                = 3 OPEN LOOP (GH)
C                                = 4 OPEN LOOP (HG)
C                                = 5 CLOSED LOOP (GH/(1+GH))
C                                = 6 CLOSED LOOP
C                                = 7 PSEUDO OPEN LOOP,
C                                  PERMITS OPENING OF A
C                                  SINGLE RETURN LOOP.
C
C                                  A MINUS SIGN ON ITYPE
C                                  EQUAL (3,4,5,OR 7) INDICATES
C                                  NEGATIVE CONTROLLER FEEDBACK.
C
C
C
```

```
C
C
C
C
C
C        LRY( 2,J) = ITFIN --- TRANSFER FUNCTION INPUT
C                              VARIABLE IDENTIFICATION.
C                              THIS INTEGER IS A LOCAL
C                              IDENTIFICATION INTEGER,
C                              REFERENCING (DEPENDING
C                              UPON ITYPE) EITHER A
C                              SENSOR SIGNAL OR A
C                              CONTROLLER OUTPUT VARIABLE
C                              WHICH IS THE  V(IN)  OF
C                              THE EXPRESSION --
C
C                                    V(OUT)
C                                  ----------  =  TF
C                                    V(IN)
C
C
C        LRY( 3,J) = JTFOUT --- TRANSFER FUNCTION OUTPUT
C                               VARIABLE IDENTIFICATION.
C                               THIS INTEGER IS A LOCAL
C                               IDENTIFICATION INTEGER,
C                               REFERENCING (DEPENDING
C                               UPON ITYPE) EITHER A
C                               SENSOR SIGNAL OR A
C                               CONTROLLER OUTPUT VARIABLE
C                               WHICH IS THE  V(OUT)  OF
C                               THE EXPRESSION --
C
C                                    V(OUT)
C                                 -----------  = TF
C                                    V(IN)
C
C
C
C        LRY( 4,J) = KPLOT
C
C                    KPLOT = 0 NO PLOTS
C                    KPLOT = 1 PLOTS WILL BE MADE
C
C        LRY( 5,J) = IAFLG
C
C                    THIS INTEGER CONTROL PARAMETER
C                    PERMITS THE USER TO SELECT
C                    THE CHARACTERISTIC ROOTS FOR A
C                    GIVEN TRANSFER FUNCTION FROM
C                    EITHER THE CHARACTERISTIC MATRIX,
C                    AR, OR ITS TRANSPOSE.
C
C                    IAFLG = 1  PROGRAM WILL USE ROOTS
C                               FROM  AR TRANSPOSE.
C
C                           DEFAULT VALUE IS 0 AND
C                           ROOTS FROM AR WILL BE USED.
C
```

```
C
C
C
C
C
C              NOTE - PROGRAM EXTRACTS ROOTS FOR BOTH
C                     AR AND ITS TRANSPOSE. THIS SERVES
C                     AS A SORT OF SELF CHECK ON THE
C                     ROOT QUALITY. ALTHOUGH IT IS A
C                     RARE OCCURRANCE, ROOTS FROM AR
C                     TRANSPOSE CAN BE -CLEANER- THAN
C                     THOSE OBTAINED FROM AR.
C
C          LRY( 6,J) = NO. OF B VARIABLES TO FEED BACK -- ITYPE = 7
C                      MAX OF 3 B VARIABLES CAN BE FED BACK FOR
C                      THE TYPE 7 PSEUDO OPEN LOOP
C                      TRANSFER FUNCTION.
C
C          LRY( 7,J) = LOCAL ID. OF FIRST  B TO RETAIN.
C
C          LRY( 8,J) = LOCAL ID. OF SECOND B TO RETAIN.
C
C          LRY( 9,J) = LOCAL ID. OF THIRD  B TO RETAIN.
C
C
C---------CALL READIM (IRY, 3, NCYC, 3, KR)
C
C          MATRIX SIZE 3 BY NCYC DEFINING EXPONENT FOR
C          TOLERANCES    TOL = (10.)**EXP
C
C          FOR THE JTH CYCLE -
C
C          IRY(1,J) = ROOT TOLERANCE EXPONENT
C          IRY(2,J) = GAIN TOLERANCE EXPONENT
C          IRY(3,J) = ROOT TOLERANCE EXPONENT USED TO
C                     REMOVE SHIFT FREQUENCY (SUBROUTINE NUMS)
C
C          NOTE -- IF ROOT OR GAIN LE TOL, THEN
C                  SET ROOT OR GAIN EQ 0.0
C
C
```

```
C
C
C
C
C
C          DO 500 ICYC=1,NCYC
C
C          IF (ITYPE .EQ. 0) GO TO 500
C
C
C---------READ(NIT,FORMAT = 20A4) (TITLE(I),I=1,20)
C
C                 80 CHARACTER TITLE FOR TRANSFER FUNCTION
C                 IDENTIFICATION
C
C
C---------READ(NIT,FORMAT = 5A4) (LPNAME(I),I=1,5)
C
C                  LPNAME(I) PERMITS UP TO 5 FOUR CHARACTER
C                            IDENTIFICATIONS WHICH SELECT THE
C                            PLOT DISPLAY MODE.
C
C                  LPNAME(I) = 4H      (ALL BLANK)NO DISPLAYS
C                                       ARE IMPLEMENTED --- GO TO 500
C                                       THE CHARACTERISTIC ROOTS
C                                       FOR THE SYSTEM ARE FOUND.
C
C                  LPNAME(I) = 4HBODE  ONLY A BODE DISPLAY.
C
C                            = 4HNICH  ONLY A NICHOLS DISPLAY.
C
C                            = 4HNYQU  ONLY A NYQUIST DISPLAY.
C
C                            = 4HNINY  BOTH NICHOLS AND NYQUIST.
C
C                            = 4HBONN  GIVES BODE, NICHOLS, NYQUIST.
C
C                            = 4HROOT  GIVES A ROOT LOCUS DISPLAY.
C
C
C
```

```
C
C
C
C
C
C       DO 500 IOP=1,5
C
C
C        IF  (LPNAME(IOP) .EQ. 4H    ) GO TO 500
C
C        IF  (LPNAME(IOP) .EQ. 4HBODE
C      *.OR. LPNAME(IOP) .EQ. 4HNICH
C      *.OR. LPNAME(IOP) .EQ. 4HNYQU
C      *.OR. LPNAME(IOP) .EQ. 4HNINY
C      *.OR. LPNAME(IOP) .EQ. 4HBONN) GO TO 200
C
C        IF  (LPNAME(IOP) .EQ. 4HROOT) GO TO 300
C
C
C   200 CONTINUE
C
C
C              *** FREQUENCY RESPONSE SECTION ***
C
C
C---------READ(NIT,FORMAT = 6F10.0) FMIN, FMAX, DBMIN, DBMAX, AMIN, AMAX
C
C                FMIN  = FREQUENCY SWEEP LOWER LIMIT
C                FMAX  = FREQUENCY SWEEP UPPER LIMIT
C                DBMIN = MINIMUM DB AMPLITUDE FOR BODE, NICHOLS PLOTS
C                DBMAX = MAXIMUM DB AMPLITUDE FOR BODE, NICHOLS PLOTS
C                AMIN  = MINIMUM AMPLITUDE FOR NYQUIST PLOTS
C                AMAX  = MAXIMUM AMPLITUDE FOR NYQUIST PLOTS
C
C
C       GO TO 500
C
C
C   300 CONTINUE
C
C
C
```

```
C
C
C
C
C
C                *** ROOT LOCUS SECTION ***
C
C
C---------CALL READIM (IJM, 2, NRLC, 2, KR)
C
C                 MATRIX SIZE 2 BY NRLC FOR ROOT LOCUS PLOT CONTROL
C
C                 NRLC = NUMBER OF ROOT LOCI TO PERFORM
C
C                 FOR THE JTH ROOT LOCI -
C
C                   IJM(1,J) = ISNIM    = 1  STARTING POINT IS
C                                            OPEN LOOP ZERO.
C                                       = 2  STARTING POINT IS
C                                            OPEN LOOP POLE.
C                                       = 3  STARTING POINT IS
C                                            CLOSED LOOP POLE.
C
C
C                   IJM(2,J) = ELEMENT LOCATION IN ROOT ARRAY
C                              FOR STARTING ROOT LOCI.
C
C
C---------CALL READ (W1, 6, NRLC, KR, KR)
C
C                 MATRIX SIZE 6 BY NRLC FOR ROOT LOCUS CONTROL DATA
C
C                 FOR THE JTH ROOT LOCI -
C
C                    W1(1,J) = THETAO(J)  INITIAL SEARCH ANGLE,
C                              NORMALLY -180. (DEGREES)
C
C                    W1(2,J) = SCL  SCALE FACTOR, NORMALLY
C                                   SCL = 1.0
C
C                    W1(3,J) = ALOC  PHASE CONTROL PARAMETER.
C                                    ALOC = +1. --- 180. DEG. PHASE.
C                                    ALOC = -1. ---   0   DEG. PHASE.
C
C                    W1(4,J) = XMIN  MIN REAL VALUE TO PLOT.
C
C                    W1(5,J) = XMAX  MAX REAL VALUE TO PLOT.
C
C                    W1(6,J) = YMAX  MAX IMAG VALUE TO PLOT AND
C                                    YMIN SET TO - YMAX.
C
C
C      500 CONTINUE
C
C          RETURN
C          END
```

V. DYNAMO OUTPUT DESCRIPTION

This section discusses the various program output information and correlates the output data with both the input data and the problem simulation. This information is presented in much the same fashion as was the input data stream of the previous chapter so as to better acquaint the reader with the actual formated output as it is presented by the program.

It is pointed out that the output stream will not reflect certain outputs that occur from routines that identify troublesome areas such as matrix singularities. Recall also that the basic input routines READ and READIM can also print out input matrix data as dictated by the user. These printouts will not be included either. Reference is made to the theoretical volume (Vol. I) and to the input data stream (Chapter IV) to correlate certain outputs with both the theory and the user input requirements.

```
C
C
C
C
C
C*****************************************************************
C*****************************************************************
C*
C*    DESCRIPTION OF PROGRAM DYNAMO OUTPUT DATA
C*
C*****************************************************************
C*****************************************************************
C
C
C-------- COMMENTS (FORMAT 13A6)
C
C                   COMMENT CARDS READ INTO THE
C                   PROGRAM WITH SUBROUTINE COMENT
C                   ARE PRINTED HERE.
C
C
C
C*****************************************************************
C*
C*    SUBROUTINE DYNSAA OUTPUT
C*
C*****************************************************************
C
C
C
C
C--------- SUMMARY OF DYNAMIC-SIMULATION INPUT DATA * * * * * * * * * *
C
C
C--------- ACTUAL SIZES  MAXIMUM SIZES  INTEGRATION DATA  GRAVITY GRADIENT DATA
C          ------------  -------------  ----------------  ---------------------
C
C--------- NB     =      NBMAX    =      STARTT =          G1    =      GAM1  =
C
C--------- NH     =      NHMAX    =      DELTAT =          G2    =      GAM2  =
C
C--------- NSPT   =      NSPMAX   =      ENDT   =          G3    =      GAM3  =
C
C--------- NOFMO  =      NMWMAX   =                        GMAG  =      RCMAG =
C
C--------- NDELTA =      NMWBOD   =
C
C--------- NU     =      NMDBOD   =                        MISC.  DATA
C                                                          -----------
C--------- NBETA  =      KMU      =
C
C--------- NLAM   =      KY       =                        NOPRNT =
C
C--------- NEQ    =      KU       =                        NOPLOT =
C
C                                                          IFLNER =
```

```
C
C
C
C
C
C                    THE FOLLOWING LIST IDENTIFIES THE
C                    OUTPUT VARIABLES SUMMARIZED ON THE
C                    PREVIOUS PAGE.
C
C
C*****************************************************************************
C
C
C                    NB     = NO. OF BODIES.
C
C                    NH     = NO. OF HINGES.
C
C                    NSPT   = NO. OF SENSOR POINTS.
C
C                    NDELTA = NO. OF CONTROL SYSTEM DELTAS.
C
C                    NU     = NO. OF U'S.
C
C                    NBETA  = NO. OF BETA'S.
C
C                    NLAM   = NO. OF LAMBDA'S (CONSTRAINTS).
C
C                    NEQ    = NO. OF STATE EQUATIONS.
C
C                    NBMAX  = MAXIMUM DIMENSIONED NO. OF BODIES.
C
C                    NHMAX  = MAXIMUM DIMENSIONED NO. OF HINGES.
C
C                    NSPMAX = MAXIMUM DIMENSIONED NO. OF SENSOR POINTS.
C
C                    NMWMAX = MAXIMUM DIMENSIONED NO. OF MOM. WHEELS.
C
C                    NMWBOD = MAXIMUM DIMENSIONED NO. OF MOM. WHEELS
C                                                        PER BODY.
C
C                    NMDBOD = MAXIMUM DIMENSIONED NO. OF MODES PER BODY.
C
C                    KMU    = MAXIMUM DIMENSIONED NO. OF U'S PER BODY,
C                           = 6 + NMDBOD + NMWBOD.
C
C                    KY     = MAXIMUM DIMENSIONED SIZE FOR STATE VECTOR.
C
C                    KU     = MAXIMUM DIMENSIONED NO. OF U'S,
C                           = NBMAX*(6 + NMDBOD) + NMWMAX.
C
C
```

```
C
C
C
C
C                       OUTPUT VARIABLE IDENTIFICATION SUMMARY
C                                    (CONT'D)
C
C
C*************************************************************************
C
C
C
C                       STARTT = START TIME FOR TIME RESPONSE.
C
C                       DELTAT = INTEGRATION STEP SIZE.
C
C                       ENDT   = END TIME FOR TIME RESPONSE.
C
C
C
C
C
C
C
C
C                       G1     = X COMPONENT OF GRAVITY VECTOR. (INPUT)
C
C                       G2     = Y COMPONENT OF GRAVITY VECTOR. (INPUT)
C
C                       G3     = Z COMPONENT OF GRAVITY VECTOR. (INPUT)
C
C                       GMAG   = SQRT(G1**2 + G2**2 + G3**2) -- ACC. OF GRAVITY.
C
C                       GAM1   = DIRECTION COSINE (GRAVITY VECTOR AND X).
C
C                       GAM2   = DIRECTION COSINE (GRAVITY VECTOR AND Y).
C
C                       GAM3   = DIRECTION COSINE (GRAVITY VECTOR AND Z).
C
C                       RCMAG  = REFERENCE RADIUS FOR ACTING GRAVITY VECTOR. (INPUT)
C
C                       NOPRNT = MULTIPLE OF DELTAT TO PRINT TIME RESPONSE.
C
C                       NOPLOT = MULTIPLE OF DELTAT TO WRITE PLOT TAPE.
C
C                       IFLNER = 0  (NON LINEAR TIME RESPONSE)
C                              = 1  (LINEAR ANALYSIS OR FREQ RESPONSE)
C
```

```
C
C
C
C
C
C                        THE FOLLOWING SERIES OF ARRAYS PERTAIN
C                        TO THE MODEL SIMULATION AND ARE PRINTED
C                        OUT AT THE BEGINNING OF EACH SIMULATION
C
C*******************************************************************
C
C
C---------THE TOPOLOGY ARRAY (ITOPOL) FOR THIS CASE FOLLOWS
C
C                          (1)    (2)   ...      (NH)
C
C---------      1    1
C---------      2    1
C
C                               THIS IS THE INPUT INTEGER ARRAY ITOPOL
C                               (SEE PREVIOUS CHAPTER -- INPUT DATA)
C
C
C---------THE CONSTRAINT SPECIFICATIONS FOR THIS CASE FOLLOW
C
C                          (1)     (2)   ...     (NH)
C
C---------      1    1
C---------      2    1
C---------      3    1          THIS IS THE INPUT INTEGER ARRAY IHDATA
C---------      4    1          (SEE PREVIOUS CHAPTER -- INPUT DATA)
C---------      5    1
C---------      6    1
C---------      7    1
C
C
C---------THE SPECIFIED INITIAL HINGE ANGLES
C         AND DISPLACEMENTS (BETAH) FOLLOW
C
C                           (1)    (2)    ...     (NH)
C
C---------      1    1
C---------      2    1      ROWS 1-3 = HINGE  ANGLES (CONSISTENT WITH ITYPE).
C---------      .    .
C---------      .    .      ROWS 4-6 = HINGE DISPLACEMENTS- Q RELATIVE TO P.
C---------      .    .
C---------      6    1
C
C
```

```
C
C
C
C
C
C---------THE SPECIFIED INITAL HINGE RATES (BETAHD) FOLLOW
C
C                    (1)    (2)    ...    (NH)
C
C---------     1  .  1
C---------     2     1      ROWS 1-3 = ANGULAR RATES.
C---------     .     .
C---------     .     .      ROWS 4-6 = DISPLACEMENT RATES- Q RELATIVE TO P.
C---------     .     .
C---------     6     1
C
C
C---------THE NO. OF ELASTIC MODES/BODY ARRAY (IRGFLX) FOLLOWS
C
C                   (1)    (2) ...  (NB)
C
C---------    1     1  THE JTH ENTRY IS THE NO. OF ELASTIC
C                      MODES FOR BODY J.
C
C
C
C---------THE NO. OF P/Q HINGE POINTS/BODY ARRAY (NHPOI) FOLLOWS
C
C                   (1)    (2) ...  (NB)
C
C---------     1     1          ELEMENTS ARE THE NO. OF P/Q
C                               HINGE POINTS ON EACH BODY.
C
C
C---------THE NO. OF SENSOR POINTS/BODY ARRAY (NSPOI) FOLLOWS
C
C                   (1)    (2) ...  (NB)
C
C---------     1     1          ELEMENTS ARE THE NO. OF SENSOR
C                               POINTS ON EACH BODY.
C
C
C---------THE MOM. WHEEL/BODY TABLE (NMOW) FOLLOWS
C
C                    (1)   (2)    ...   (NB)
C
C---------     1     1 COL  J = JTH BODY
C---------     2     1 ROW  1 = NO. OF MOM. WHEELS ON BODY J.
C---------     .     . ROW  2 = NO. OF VARIABLE SPEED WHEELS ON BODY J.
C---------     .     . ROW  3 = SUCCESSIVE ROWS ARE THE MOMENTUM WHEEL NUMBERS
C---------     .     .   .      ON BODY J (IN ASCENDING ORDER).
C--------2+NMWBOD    1   .
C
C
C
```

```
C
C
C
C
C
C---------THE STATE VECTOR LENGTH ARRAY (LENU) FOLLOWS
C
C                      (1)   (2)   ... (2*NB + 2)
C
C---------     1     1
C
C                   THE ELEMENTS ARE THE LENGTHS OF SEGMENTS
C                   OF THE STATE VECTOR.
C
C                   ORDER IS
C
C                        U(1),U(2),..,U(NB),XI(1),...,XI(NB),BETA,DELTA
C
C
C---------THE STATE VECTOR LOCATION ARRAY (LOCU) FOLLOWS
C
C                      (1)   (2)   ... (2*NB + 2)
C
C---------     1     1
C
C                     LEADING ELEMENT LOCATION IN THE STATE VECTOR
C                     FOR THE SEGMENTS DESCRIBED IN ARRAY (LENU).
C
C
C---------THE SPECIFIED SENSOR POINT/BODY CORRELATION ARRAY (IFTSMW) FOLLOWS
C
C                      (1)   (2)   ... (NSPT)
C
C---------     1     1   THE JTH ELEMENT IS THE BODY NO. ON
C                        WHICH SENSOR POINT J IS LOCATED.
C
C
C
```

```
C
C
C
C
C
C---------THE FOLLOWING DATA IS SPECIFIED MOM. WHEEL INFORMATION (IF ANY)
C                        AND CONTROLLER INFORMATION
C
C
C---------THE SPECIFIED MOM. WHEEL CONTROL ARRAY (IMO) FOLLOWS
C
C                   (1)    (2)   ...  (NOFMO)
C
C                     COL J = JTH MOMENTUM WHEEL
C---------     1    1     ROW 1 = WHEEL SENSOR POINT NO.
C---------     2    1     ROW 2 = SPIN AXIS
C---------     3    1     ROW 3 = 1  ACTIVE
C                               = 0 CONSTANT SPEED
C
C
C---------THE SPECIFIED MOM. WHEEL RATES AND INERTIAS (AMO) FOLLOW
C
C                   (1)    (2)   ...  (NOFMO)
C
C                     COL J = JTH MOMENTUM WHEEL
C---------     1    1     ROW 1 = INITIAL WHEEL SPIN RATE
C---------     2    1     ROW 2 = SPIN INERTIA
C
C
C---------THE SPECIFIED CONTROLLER INITIAL CONDITIONS
C         AND CHARACTERISTICS FOLLOW
C           (THE FIRST NDELTA ARE INITIAL CONTROLLER STATE
C            VARIABLES, THERE ARE   K ADDITIONAL PARAMETERS)
C
C                 THIS IS THE USER INPUT ARRAY CNTDTA.
C
C                 THE ADDITIONAL K PARAMETERS, IF ANY, ARE
C                 AVAILABLE TO THE USER FOR USER-PAK DATA.
C
C                 THE FIRST NDELTA ENTRIES IN THIS ARRAY
C                 ARE THE INITIAL CONDITIONS FOR THE
C                 CONTROL VARIABLES.
C
C
C
C**********************************************************************
C**********************************************************************
```

```
C
C
C
C
C
C*****************************************************************************
C*
C*    SUBROUTINE MRIGID -- OUTPUT FOR RIGID BODY
C*
C*****************************************************************************
C
C                 THE FOLLOWING IS TYPICAL FOR THE ITH BODY
C
C----------       SUMMARY OF INPUT DATA FOR BODY  I  WHICH IS RIGID.
C
C----------THE 6X6 INERTIA MATRIX IS --
C
C                    (1)      (2)      (3)      (4)      (5)      (6)
C
C------      1     1  IXX     -IXY     -IXZ      0       -SZ       SY
C------      2     1 -IYX      IYY     -IYZ      SZ       0       -SX
C------      3     1 -IZX     -IZY      IZZ     -SY       SX        0
C------      4     1   0        SZ     -SY       M        0        0
C------      5     1  -SZ       0       SX       0        M        0
C------      6     1   SY     -SX       0        0        0        M
C
C
C----------FOR BODY  I THE P-Q HINGE NO. AND THE EULER ROTATION TYPE
C          APPEAR IN THE FOLLOWING INTEGER ARRAY WHICH IS FOLLOWED BY
C          AN ARRAY CONTAINING EULER ANGLES (1,2,3), AND POSITION
C          VECTOR COMPONENTS (4,5,6) THAT POSITION THE HINGE TRIAD
C          WRT THE BODY TRIAD
C
C                                -----  DATA HERE  -----
C
C
C          IF BODY I HAS ANY SENSOR POINTS,
C          THE FOLLOWING WILL BE PRINTED
C
C
C----------FOR BODY  I THE SENSOR POINT NO. AND THE EULER ROTATION TYPE
C          APPEAR IN THE FOLLOWING INTEGER ARRAY WHICH IS FOLLOWED
C          BY AN ARRAY CONTAINING EULER ANGLES (1,2,3), AND POSITION
C          VECTOR COMPONENTS (4,5,6) THAT POSITION THE SENSOR TRIAD
C          WRT THE BODY TRIAD
C
C
C
C                                -----  DATA HERE  -----
C
C
C*****************************************************************************
C*****************************************************************************
```

```
C
C
C
C
C
C*********************************************************************
C*
C*    SURROUTINE MSMODC - OUTPUT FOR FLEXIBLE BODY, CONSISTENT MASS MATRIX
C*
C*********************************************************************
C
C
C                         TYPICAL OUTPUT FOR ITH BODY
C
C
C          THIS SUBROUTINE PRINTS OUT SEVERAL MATRICES THAT ARE
C          RELATED TO THE FORM OF THE GOVERNING EQUATIONS.
C
C          THE READER WILL BE REFERRED TO VOL I AND THE INPUT
C          DATA STREAM FOR FURTHER CLARIFICATION.
C
C----------SUMMARY OF INPUT DATA FOR BODY I WHICH IS
C          FLEXIBLE W/CONSISTENT MASS MATRIX.
C
C
C----------THE INPUT PARAMETERS--- IFRBM, IFDIAK, IFDIAD ARE
C
C                             SEE INPUT DATA FOR MSMODC
C
C
C----------THE JDOF TABLE FOLLOWS---
C
C                             DEGREE OF FREEDOM AS INPUT
C
C                             SEE INPUT DATA FOR MSMODC
C
C
C----------THE MODE SELECTION VECTOR FOLLOWS
C
C                             MODE SELECTION VECTOR AS INPUT
C
C                             SEE INPUT DATA FOR MSMODC
C
C
C----------FOR BODY NO.  I    THE POSITION VECTOR FROM THE BODY ORIGIN
C                             TO JOINT K IS
C
C                             X =         Y =         Z =
C
C                             WHERE   K IS JOINT COORDINATES
C                             USED TO DEVELOP RIGID BODY MODES
C
C                             SEE INPUT DATA FOR MSMODC
C
```

```
C
C
C
C
C
C---------THE CONSISTENT, REPARTITIONED MASS MATRIX IS--
C
C                          THIS IS THE REPARTITIONED MASS
C                          MATRIX AND IS CONSISTENT WITH
C                          THE JDOF TABLE.
C
C
C---------THE REPARTITIONED MODAL MATRIX IS---
C
C                          THIS IS THE REPARTITIONED MODAL
C                          MATRIX. THE ROWS ARE CONSISTENT
C                          WITH THE REPARTITIONED MASS MATRIX
C                          AND THE COLS ARE CONSISTENT WITH
C                          THE ELEMENTS OF THE MODE SELECTION
C                          VECTOR.
C
C
C---------THE  -UNDEFORMED-  INERTIA MATRIX (MU) IS---
C
C                          THIS IS THE M0 MATRIX NOTED AS
C                          EQ. II-87 OF VOL I
C
C
C---------
C          THERE THEN FOLLOWS MATRICES
C
C                    A      COEFFICIENTS
C                    B      COEFFICIENTS
C                 COFXY  COEFFICIENTS
C                 COFXZ  COEFFICIENTS
C                 COFYZ  COEFFICIENTS
C
C          WHICH ARE THE  ALPHA, B, AND C COEFFICIENTS
C          GIVEN AS EQ. II-88 OF VOL I
C
C
C---------
C          THERE THEN FOLLOWS MATRICES
C
C                          C11, C22, C33,
C                          C12, C13, C23
C
C          WHICH ARE IDENTIFIED AS EQ. II-89 OF VOL I
C
```

```
C
C
C
C
C
C
C---------THE MODAL STIFFNESS IS --
C
C         -----  DATA HERE  -----
C
C
C---------THE MODAL DAMPING MATRIX IS --
C
C         -----  DATA HERE  -----
C
C
C---------
C          THERE FOLLOWS TWO ARRAYS CONTAINING THE
C
C                              INITIAL MODAL DISPLACEMENTS AND
C                              INITIAL MODAL VELOCITIES RESPECTIVELY.
C
C
C---------FOR BODY I THE P-Q HINGE NO., THE EULER ROTATION TYPE
C         AND THE JOINT NO. CORRESPONDING TO THE P-Q HINGE
C         APPEAR IN THE FOLLOWING INTEGER ARRAY WHICH IS FOLLOWED BY AN
C         ARRAY CONTAINING EULER ANGLES THAT POSITION THE HINGE
C         TRIAD WRT THE BODY TRIAD
C
C                    ----  DATA HERE  -----
C
C
C         IF BODY I HAS ANY SENSOR POINTS,
C         THE FOLLOWING WILL BE PRINTED
C
C
C---------FOR BODY I THE SENSOR POINT NO., THE EULER ROTATION TYPE
C         AND THE JOINT NO. CORRESPONDING TO THE SENSOR POINT
C         APPEAR IN THE FOLLOWING INTEGER ARRAY WHICH IS FOLLOWED
C         BY AN ARRAY CONTAINING EULER ANGLES THAT POSITION THE
C         SENSOR TRIAD WRT THE BODY TRIAD
C
C                    ----  DATA HERE  -----
C
C
C
C*********************************************************************
C*********************************************************************
```

```
C
C
C
C
C
C*****************************************************************
C*
C*    SUBROUTINE MSMODL - OUTPUT FOR FLEXIBLE BODY, LUMPED MASS MATRIX
C*
C*****************************************************************
C
C
C                         TYPICAL OUTPUT FOR THE ITH BODY
C
C
C        THIS SUBROUTINE PRINTS OUT SEVERAL MATRICES THAT ARE
C        RELATED TO THE FORM OF THE GOVERNING EQUATIONS.
C
C
C        THE READER WILL BE REFERRED TO VOL I AND THE INPUT
C        DATA STREAM FOR FURTHER CLARIFICATION.
C
C
C---------OUTPUT MATRICES  INERO, STATO, MASSO, DOCOEF, AOCOEF, ECOEF
C
C                          ARE THE J, -S, M, D, A, E, PARTITIONS
C                          RESPECTIVELY OF THE MATRIX MO OF EQ. II-87
C                          OF VOL I
C
C
C---------OUTPUT MATRIX    MUO IS MATRIX MO OF EQ. II-87 OF VOL I
C
C
C---------OUTPUT MATRICES  ACOF, BCOF, CXY, CXZ, CYZ,
C
C                          ARE THE  ALPHA, B, AND C
C                          COEFFICIENTS IN THE MATRIX
C                          GIVEN AS EQ. II-88 OF VOL I
C
C
```

```
C
C
C
C
C
C
C
C----------OUTPUT MATRICES  C11, C22, C33,
C                           C12, C13, C23
C
C                           ARE THE CONSTITUENTS OF THE
C                           MATRIX GIVEN AS EQ. II-89 OF VOL I
C
C
C----------OUTPUT MATRIX XE0
C
C                           CONTAINS THE INITIAL MODAL
C                           DEFLECTIONS. (AS INPUT)
C
C
C----------OUTPUT MATRIX XE0D
C
C                           CONTAINS THE INITIAL MODAL
C                           VELOCITIES.  (AS INPUT)
C
C
C----------FOR BODY I THE P-Q HINGE NO., THE EULER ROTATION TYPE
C          AND THE JOINT NO. CORRESPONDING TO THE P-Q HINGE
C          APPEAR IN THE FOLLOWING INTEGER ARRAY WHICH IS FOLLOWED BY AN
C          ARRAY CONTAINING EULER ANGLES THAT POSITION THE HINGE
C          TRIAD WRT THE BODY TRIAD
C
C                      ----  DATA HERE  -----
C
C
C          IF BODY I HAS ANY SENSOR POINTS,
C          THE FOLLOWING WILL BE PRINTED
C
C
C----------FOR BODY I THE SENSOR POINT NO., THE EULER ROTATION TYPE
C          AND THE JOINT NO. CORRESPONDING TO THE SENSOR POINT
C          APPEAR IN THE FOLLOWING INTEGER ARRAY WHICH IS FOLLOWED
C          BY AN ARRAY CONTAINING EULER ANGLES THAT POSITION THE
C          SENSOR TRIAD WRT THE BODY TRIAD
C
C                      ----  DATA HERE  -----
C
C
C
C**********************************************************************
C**********************************************************************
```

```
C
C
C
C
C
C        IF THE USER UTILIZES POLYNOMIAL INPUT FOR
C        CONTROL SYSTEM TRANSFER FUNCTIONS, THE FOLLOWING
C        MATRIX WILL BE PRINTED.
C
C
C---------OUTPUT MATRIX CPLY(KPLY,2*NPLY)
C
C            WHERE KPLY = ROW DIMENSION SIZE OF CPLY IN SUBROUTINE CONTRL
C
C                  NPLY = NO. OF INPUT POLYNOMIAL RATIOS
C
C            AND FOR I = ODD INTEGER --
C
C                COL I   = DENOMINATOR POLYNOMIAL COEFFICIENTS
C                          IN ASCENDING ORDER
C
C                COL I+1 = NUMERATOR POLYNOMIAL COEFFICIENTS
C                          IN ASCENDING ORDER
C
C
C---------THE FOLLOWING INTEGER ARRAY (INDEP) PRESCRIBES INDEPENDENT
C         VARIABLES (1) AND DEPENDENT VARIABLES (0)
C
C                        THE ELEMENTS OF THIS ARRAY IDENTIFY
C                        WHICH VARIABLES SURVIVE IN THE FINDU
C                        SEARCH TO DETERMINE AN INDEPENDENT
C                        SET TO BE INTEGRATED.
C
C                        THE SURVIVING VARIABLES WILL ALSO
C                        REPRESENT THE FIRST NX ROWS OF
C                        THE LINEARIZED MATRIX, A, USED
C                        BY SUBROUTINE DYNSDD.
C
C                        NOTE -  NX = NO. OF NON-ZERO ENTRIES IN ARRAY INDEP
C
C
C
C
C
C*********************************************************************
C*********************************************************************
```

```
C
C
C
C
C
C*********************************************************************
C*
C*    SURROUTINE DYNSBB OUTPUT
C*
C*********************************************************************
C
C
C                 THE PRINTOUT IS TYPICAL FOR A GIVEN SIMULATION TIME, T.
C
C                 THE T=0  PRINT OUT IS ALWAYS GIVEN
C                         (EVEN FOR A LINEARIZED ANALYSIS)
C
C
C                 THE DATA ARE PRESENTED IN VECTOR FORM AND
C                 ORDERED AS FOLLOWS---
C
C---------THE STATE VECTOR Y =
C
C---------THE STATE VECTOR TIME DERIVATIVE YDT =
C
C---------THE BETAS (EULER ANGLES, POSITION COORDINATES) ARE
C
C---------THE BETA TIME DERIVATIVES ARE
C
C---------THE DELTAS (CONTROL SYSTEM VARIABLES) ARE
C
C---------THE DELTA TIME DERIVATIVES ARE
C
C
C
```

```
C
C
C
C
C
C----------
C          THE FOLLOWING INFORMATION IS TYPICAL FOR BODY I.
C
C
C----------FOR BODY I  THE VELOCITIES ARE
C
C            ORDER IS     OMGX
C                         OMGY     BODY ANGULAR VELOCITY
C                         OMGZ
C
C                           U
C                           V      BODY TRANSLATIONAL VELOCITY
C                           W
C
C                         XID(1)
C                         XID(2)
C                           .      BODY MODAL VELOCITIES
C                           .
C                           .
C                         XID(NE)
C
C                        THETAD(1)
C                           .       MOMENTUM WHEEL ANGULAR VELOCITY
C                           .       (RELATIVE TO SENSOR POINT TRIAD)
C                           .            (ACTIVE WHEEL)
C
C
C----------FOR BODY I THE CORRESPONDING MOMENTA ARE
C
C              ORDER IS     HX
C                           HY   BODY AXES REF. ANGULAR MOMENTUM
C                           HZ   (INCLS CONTRIBUTION OF CONST. SPEED WHEEL)
C
C                           LX
C                           LY   BODY AXES REF. LINEAR MOMENTUM
C                           LZ
C
C                         P XI(1)
C                         P XI(2)
C                           .    BODY AXES REF. MODAL MOMENTUM
C                           .
C                           .
C                         P XI(NE)
C
C                         H MW(1)
C                           .    BODY AXES REF. MOM WHEEL MOMENTUM
C                           .    (ACTIVE WHEEL)
C                           .
C
C
```

```
C
C
C
C
C
C
C---------FOR BODY I ITS CONTRIBUTION TO TOTAL ANGULAR
C                    AND LINEAR MOMENTUM IS
C
C              ORDER IS     HX
C                           HY  ANGULAR MOMENTUM
C                           HZ
C                           (REFERENCED TO INERTIAL ORIGIN)
C                           LX
C                           LY  LINEAR MOMENTUM
C                           LZ
C
C
C---------FOR BODY I ITS CONTRIBUTION TO TOTAL KINETIC AND
C                    POTENTIAL ENERGIES IS
C
C
C---------FOR BODY I  THE ELASTIC DEFLECTIONS ARE
C
C
C---------THE INTERCONNECTION CONSTRAINT FORCES (LAMBDAS) ARE
C
C
C---------THE TOTAL ANGULAR MOMENTUM VECTOR IS
C
C                   X,Y,Z  COMPONENTS IN INERTIAL REF. AXIS SYSTEM.
C
C
C---------THE TOTAL LINEAR MOMENTUM VECTOR IS
C
C                   X,Y,Z  COMPONENTS IN INERTIAL REF. AXIS SYSTEM.
C
C
C---------THE TOTAL ANGULAR MOMENTUM =
C---------THE TOTAL LINEAR MOMENTUM  =
C---------THE TOTAL KINETIC ENERGY   =
C---------THE TOTAL POTENTIAL ENERGY =
C---------THE TOTAL ENERGY (T+V)     =
C
C
C
C**********************************************************************
C**********************************************************************
```

```
C
C
C
C
C
C
C*******************************************************************
C*
C*    SUBROUTINE DYNSCC OUTPUT
C*
C*******************************************************************
C
C
C
C---------            SUMMARY OF PLOTTING INFORMATION
C
C
C                     THE OUTPUT SUMMARIZES THE INPUT DATA
C                     WHICH CONTROLLED THE TIME RESPONSE
C                     PLOT LOGIC.
C
C                        SEE INPUT DATA FOR DYNSCC FOR
C                        DETAILED DESCRIPTIONS.
C
C
C                  NOTE- THE OUTPUT VARIABLE NRPLOT
C                        IS THE NO. OF LOGICAL RECORDS
C                        WRITTEN ON THE PLOT TAPE.
C
C
C
C
C*******************************************************************
C*******************************************************************
```

```
C
C
C
C
C
C
C*****************************************************************
C*
C*  SUBROUTINE DYNSDD OUTPUT - LINEARIZED SYSTEM ANALYSIS
C*
C*****************************************************************
C
C
C---------OUTPUT MATRIX -A- (NJQ,NX)
C
C                          NJQ = TOTAL NO. OF EQUATIONS
C                                LINEARIZED (INCLUDING
C                                AUXILIARY EQUATIONS FROM
C                                SUBROUTINE EQADD)
C
C                          NX  = NO OF INDEPENDENT STATE EQUATIONS
C                                DETERMINED BY FINDU IN DYNSBB.
C
C
C                          THIS IS THE MATRIX OF PARTIAL DERIVATIVES
C                          WHICH ARE THE LINEARIZED COMPONENTS OF THE
C                          STATE VARIABLES AS DETERMINED BY
C                          SUBROUTINE LINEAR.
C
C
C                          THE ORDER OF THE VARIABLES FOR THE
C                          ROWS IS
C
C                                                SIZE
C
C                              PLANT VARIABLES   NY
C
C                              CONTROL VARIABLES NDELTA
C
C                              CONTROLLER OUTPUTS NBTQ
C
C                              SENSOR SIGNALS    NXSS
C
C
C
C                          THE COLUMN ORDER IS
C
C                              PLANT VARIABLES   NY
C
C                              CONTROL VARIABLES NDELTA
C
```

```
C
C
C
C
C
C
C---------OUTPUT MATRIX -T- (NX,NX)
C
C                         THIS IS THE SIMILARITY
C                         TRANSFORMATION MATRIX
C                         THAT INTRODUCES THE (NBTQ + NXSS)
C                         AUXILIARY VARIABLES INTO THE
C                         TRANSFORMED STATE EQUATIONS.
C
C                         REF. MATRIX R IN EQ. III-24 OF VOL I
C
C
C---------OUTPUT MATRIX  Y* (1,NX)
C
C                       THIS IS THE TRANSFORMED STATE
C                       VECTOR INITIAL CONDITIONS.
C
C                       REF. VECTOR Z IN EQ. III-24 OF VOL I
C
C
C---------OUTPUT MATRIX A* (NX,NX)
C
C                       THIS IS THE TRANSFORMED, LINEARIZED
C                       STATE VARIABLE COEFFICIENT MATRIX
C                       THAT IS THE BASIS FOR THE ENTIRE
C                       LINEARIZATION PACKAGE.
C
C                       REF. EQ. III-28 OF VOL I
C
C                       THE ROW/COL VARIABLE ORDERING AND
C                       SIZES ARE:
C
C                         VARIABLE ID.                SIZE
C                         ------------                ----
C
C                         PLANT VARIABLES              NY2
C
C                         PLANT SENSOR SIGNALS         NXSS
C
C                         CONTROL SYSTEM VARIABLES     ND2
C
C                         CONTROL OUTPUTS (B'S)        NBTQ
C
C
C                  NOTE-  NY2 = NY - NXSS
C
C                         ND2 = NDELTA - NBTQ
C
```

```
C
C
C
C
C
C---------              RT A                                RTA*
C
C              REAL PART  IMAGINARY PART        REAL PART  IMAGINARY PART
C
C
C                                COMPLEX ROOTS OBTAINED FROM
C                                  A AND A* RESPECTIVELY.
C
C
C                                  THESE ARE THE POLES OF
C                                  THE CLOSED LOOP SYSTEM.
C
C
C***************************************************************************
C
C
C                THE FOLLOWING OUTPUTS ARE CHARACTERISTIC OF
C                A SINGLE TRANSFER FUNCTION FREQUENCY RESPONSE.
C
C
C---------OUTPUT MATRIX -AR-
C
C                                THIS IS THE REDUCED A* MATRIX
C                                FOR A PARTICULAR USER SPECIFIED
C                                TRANSFER FUNCTION TYPE.
C
C                                REF. INPUT DATA LIST AND
C                                CHAPTER III OF VOL I
C
C                                THE ROOTS OF AR  ARE THE
C                                TRANSFER FUNCTION POLES.
C
C
C---------OUTPUT MATRIX BCOL
C
C                                THIS IS THE VECTOR (COL) WITH WHICH
C                                AR IS AUGMENTED TO DETERMINE THE
C                                TRANSFER FUNCTION ZEROS.
C
```

```
C
C
C
C
C
C
C---------         R AR                           RART
C
C        REAL PART  IMAGINARY PART     REAL PART  IMAGINARY PART
C
C
C                           THESE ARE THE COMPLEX ROOT ARRAYS
C                           AS EXTRACTED FROM MATRICES
C                           AR AND AR TRANSPOSE RESPECTIVELY.
C
C                           THE USER SELECTS VIA INPUT WHICH
C                           SET OF ROOTS TO USE FOR THE POLES.
C
C
C---------          NUM                           DEN
C
C        REAL PART  IMAGINARY PART     REAL PART  IMAGINARY PART
C                   .                             .
C                   .                             .
C                   .                             .
C
C             NUMERATOR ROOTS                DENOMINATOR ROOTS
C
C         (TRANSFER FUNCTION ZEROS)     (TRANSFER FUNCTION POLES)
C
C                   .                             .
C                   .                             .
C                   .                             .
C
C
```

C-2

```
C
C
C
C
C
C
C---------OUTPUT MATRIX RRED
C
C
C          TRANSFER FUNCTION ROOT ARRAY CONTAINING ROOT
C          COUNTS, TIME CONSTANTS, DAMPING, AND FREQUENCY
C          FOR ZEROS AND POLES.
C
C
C              ELE 1 = NO. OF NUMERATOR REAL ROOTS,       NNR
C
C              ELE 2 = NO. OF NUMERATOR COMPLEX PAIRS,    NNC
C
C              ELE 3 = NO. OF NUMERATOR FREE S'S,         NNZ
C
C              ELE 4 = NO. OF DENOMINATOR REAL ROOTS,     NDR
C
C              ELE 5 = NO. OF DENOMINATOR COMPLEX PAIRS,NDC
C
C              ELE 6 = NO. OF DENOMINATOR FREE S'S,       NDZ
C
C              ELE 7 = BODE GAIN, KB.
C
C
C                   THE ROOTS FOLLOW IN THE ORDER
C
C
C         ELEMENT LOCATION           DESCRIPTION
C         ----------------           -----------
C
C            8 THRU NNR+7            NUMERATOR TIME CONSTANTS
C
C        NNR+8 THRU 2*NNC + 7        NUMERATOR DAMPING AND FREQUENCIES --
C
C                                    ZETA1, OMEGA1, ZETA2, OMEGA2 ---
C                   FREE S'S ARE NOT INCLUDED
C
C
C          REMAINING ELEMENTS ARE DEMONINATOR ROOTS IN SAME
C          ORDER AS NUMERATOR ROOTS, IE.,
C
C          TAU(1),...,TAU(NDR),ZETA(1),OMEGA(1),...,ZETA(NDC),OMEGA(NDC)
C
C
```

```
C
C
C
C
C
C              THE TRANSFER FUNCTION FREQUENCY RESPONSE FOLLOWS
C
C
C--------- FREQ/RAD/SEC   FREQ/HERTZ  REAL   IMAG   AMP  DECIBELS   RAD    DEG
C                   .                 .                 .
C                   .                 .                 .
C                   .                 .                 .
C
C
C              THE DAMPED RESONANCES (BASED ON A
C              POLE OR ZERO) ARE IDENTIFIED
C              BY  *****  IN BOTH THE LEFT AND RIGHT MARGINS.
C
C
C              ****************************************
C
C
C             THE FOLLOWING OUTPUTS ARE TYPICAL OF A ROOT
C             LOCUS INVESTIGATION.
C
C
C---------OUTPUT MATRICES   PDEN
C                           PNUM
C
C                          THE DENOMINATOR AND NUMERATOR
C                          TRANSFER FUNCTION POLYNOMINAL
C                          COEFFICIENTS --- ASCENDING POWERS OF S.
C---------
C          P(S) =      NUMERATOR
C                        AND
C          Q(S) =      DEMONINATOR
C
C               PREPROCESSED
C               POLYNOMINAL COEFFICIENTS AS USED BY RLOCUS.
C
C
C---------  STARTING POINT =  USER IDENTIFIED STARTING POINT
C                             FOR THE LOCI.
C
C---------  SCAN LIMITS    =   LIMITS ON REAL AND IMAGINARY
C                              COMPONENTS FOR THE LOCI.
C
C
C---------    GAIN              ROOTS             ERROR
C
C
C                          ROOT LOCUS OUTPUT
C
C
C
C*********************************************************************
C*********************************************************************
```

VI. EXAMPLES

A. THE SPACELAB INSIDE-OUT GIMBAL CONCEPT - TIME RESPONSE SIMULATION

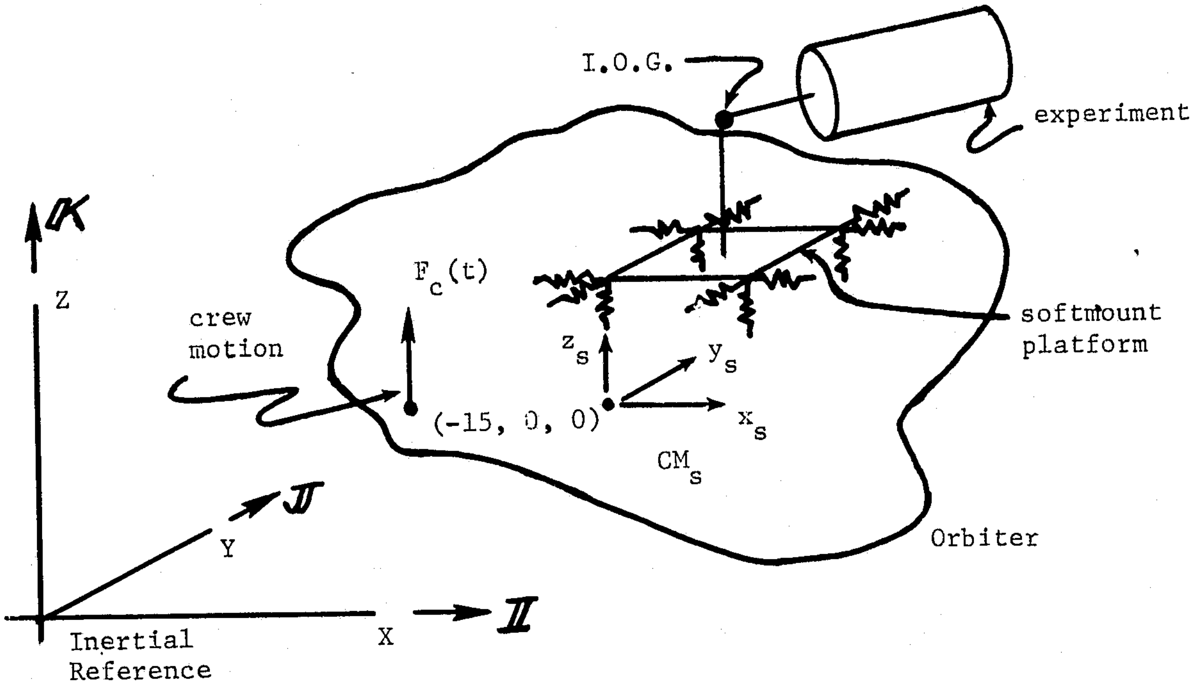


Figure VI-1. Schematic of Spacelab IOG Concept

The first demonstration problem (IOG-1) considers a three-body, three-hinge configuration in the time domain. The first body (the Shuttle orbiter) has a crew motion force acting on the $-X_S$ axis 15-meters from the bodies mass center. The schematic is as shown in Figure VI-1. The orbiter is considered to be rigid.

The second body is the soft mount platform which consists of a rigid platform and rod, fastened to the orbiter with 6-DOF springs and dampers. The translational spring rates are 10,000 n/m in each axis while the rotational spring rates are 625 nm.

The translational and rotational dampers have values of 63.43 n-sec/m and 1015 n-m-sec, respectively.

The inside-out gimbal connects the experiment to the soft mount platform. A (3-2-1) Euler angle permutation is used to orient the experiment with respect to the inertial reference frame; and, also, the instrument relative to the soft mount platform. Thus, the direction cosines relating attitudes of body fixed axes (in the instrument) to inertial axes are given by

$$\begin{Bmatrix} \mathbb{I} \\ \mathbb{J} \\ \mathbb{K} \end{Bmatrix} = \left[\begin{array}{c|c|c} \cos\alpha\cos\beta & \begin{array}{l}-\sin\alpha\cos\gamma \\ +\cos\alpha\sin\beta\sin\gamma\end{array} & \begin{array}{l}\sin\alpha\sin\gamma \\ +\cos\alpha\sin\beta\cos\gamma\end{array} \\ \hline \sin\alpha\cos\beta & \begin{array}{l}\cos\alpha\cos\gamma \\ +\sin\alpha\sin\beta\sin\gamma\end{array} & \begin{array}{l}-\cos\alpha\sin\gamma \\ +\sin\alpha\sin\beta\cos\gamma\end{array} \\ \hline -\sin\beta & \cos\beta\sin\gamma & \cos\beta\cos\gamma \end{array}\right] \begin{Bmatrix} \bar{i}_I \\ \bar{j}_I \\ \bar{k}_I \end{Bmatrix}$$

with α the first rotation (about the $\mathbb{K}$ axis)

β the second rotation (about the $\bar{j}'$ axis)

and γ the third rotation (about the $\bar{i}_I$ axis)

The direction cosines $[ROL]$ given above are always available in the program (labeled common /BHBSRD/) and it follows that attitude errors (for body 3, the instrument) are given as

$$\Delta\alpha = \arctan\left(\frac{ROL\ (2,1,3)}{ROL\ (1,1,3)}\right)$$

$$\Delta\beta = -\arcsin\Big(ROL\ (3,1,3)\Big) - \pi/3$$

and $$\Delta\gamma = \arctan\left(\frac{ROL\ (3,2,3)}{ROL\ (3,3,3)}\right)$$

In the case of $\Delta\beta$, a 60° look angle is subtracted from the global position angle .

A simple position/rate feedback control law is used (no filtering and ideal gimbal torque assumed) thus, the gimbal torques are given by

$$T_g(\text{inner}) = -K_o \Delta\alpha \quad -K_1 \Delta\dot{\alpha}$$

$$T_g(\text{middle}) = -K_o \Delta\beta \quad -K_1 \Delta\dot{\beta}$$

$$T_g(\text{outer}) = -K_o \Delta\gamma \quad -K_1 \Delta\dot{\gamma}$$

with $K_o = 1.8653\text{x}10^6$ n-m/rad,
$K_1 = 8.396\text{x}10^4$ n-m-sec

and with attitude rates given by

$$\begin{Bmatrix} \Delta\dot{\alpha} \\ \Delta\dot{\beta} \\ \Delta\dot{\gamma} \end{Bmatrix} \left[\begin{array}{c|c|c} 0 & \sin\gamma/\cos\beta & \cos\gamma/\cos\beta \\ \hline 0 & \cos\gamma & -\sin\gamma \\ \hline 1 & \sin\gamma \sin\beta/\cos\beta & \cos\gamma \sin\beta/\cos\beta \end{array}\right] \begin{Bmatrix} \omega_x \\ \omega_y \\ \omega_z \end{Bmatrix}_{(\text{instrument})}.$$

The gimbal torques are applied to the instrument (backed up by the soft mount platform and orbiter) so as to cause its attitude and rate errors with respect to the inertial frame to vanish. This is feasible providing that the orbiter/soft mount combination is massive with respect to the instrument and there is attitude control for the orbiter.

Orbiter attitudes, gimbal angles and a variety of other configuration states are monitored and plotted as a function of time. System response is caused by crew motion force which is shown in Figure VI-2.

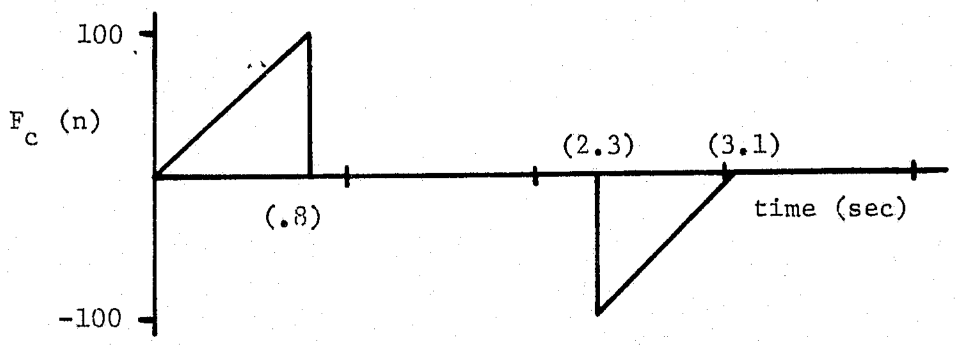


Figure VI-2. Crew Motion Force

The inertial properties used for the three bodies are tabulated in Table VI-1.

Table VI-1. Inertial Properties

	Shuttle	Mount	Instrument
mass (Kg)	72,497	195	2380
Inertias (Kgm^2)			
I_{xx}	1.001×10^6	50.	2263
I_{yy}	7.44×10^6	50.	2263
I_{zz}	7.65×10^6	50.	2530

Assuming that the body fixed axis systems are nominally aligned, the position vectors to several specific points are given in Table VI-2 below, where the position vector is referenced to the shuttle system.

Table VI-2. Geometric Properties

Point	x_s (m)	y_s (m)	z_s (m)
Platform Mass Center	2.2	0.	0.375
IOG	2.2	0.	0.750
Instrument Mass Center	2.2	0.	2.600
Application of Crew Motion Force	-15.0	0.	0.
Control of Soft Mount Platform	2.2	0.	0.

RUN NO. 10G 1 DATE 082175 PAGE NO. 1

RUN BY

SPACELAB - INSIDE OUT GIMBAL CONCEPT
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 054638
THE CPU TIMER = 15 SEC

SUMMARY OF DYNAMIC-SIMULATION-PROGRAM INPUT DATA * * * * * * * * * * * *

ACTUAL SIZES	MAXIMUM SIZES	INTEGRATION DATA	GRAVITY GRADIENT DATA		MISC. DATA
NB = 3	NBMAX = 5	STARTT = 0.000	G1 = 0.000	GAMA1 = 0.000	NOPRNT = 5
NH = 3	NHMAX = 5	DELTAT = 2.000-002	G2 = 0.000	GAMA2 = 0.000	NOPLOT = 1
NSPT = 2	NSPMAX = 10	ENDT = 4.000+000	G3 = 0.000	GAMA3 = 0.000	IFLNER = 0
NOFMO = 0	NMWMAX = 5		GMAG. = 0.000	RCMAG = 0.000	
NDELTA = 6	NMWBOD = 3				
NU = 18	NMDBOD = 6				
NBETA = 15	KMU = 15				
NLAM = 3	KY = 250				
NEQ = 39	KU = 65				

THE TOPOLOGY ARRAY (ITOPOL) FOR THIS CASE FOLLOWS

		(1)	(2)	(3)
1	1	1	2	3
2	1	0	1	2

THE CONSTRAINT SPECIFICATIONS FOR THIS CASE FOLLOW

		(1)	(2)	(3)
1	1	12	12	12
2	1	0	0	0
3	1	0	0	0
4	1	0	0	0
5	1	0	0	1
6	1	0	0	1
7	1	0	0	1

ORIGINAL PAGE IS OF POOR QUALITY

THE SPECIFIED INITIAL HINGE ANGLES AND DISPLACEMENTS (BETAH) FOLLOW

		(1)	(2)	(3)
1	1	0.000	0.000	0.000
2	1	0.000	0.000	1.047+000
3	1	0.000	0.000	0.000
4	1	0.000	0.000	0.000
5	1	0.000	0.000	0.000
6	1	0.000	0.000	0.000

THE SPECIFIED INITIAL HINGE RATES (BETAHD) FOLLOW

		(1)	(2)	(3)
1	1	0.000	0.000	0.000
2	1	0.000	0.000	0.000
3	1	0.000	0.000	0.000
4	1	0.000	0.000	0.000
5	1	0.000	0.000	0.000

VI-6 6 1 0.000 0.000 0.000

SPACELAB - INSIDE OUT GIMBAL CONCEPT
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 054638
THE CPU TIMER = 15 SEC

THE NO. OF ELASTIC MODES/BODY ARRAY (IRGFLX) FOLLOWS

		(1)	(2)	(3)
1	1	0	0	0

THE NO. OF P/Q HINGE POINTS/BODY ARRAY (NHPOI) FOLLOWS

		(1)	(2)	(3)
1	1	1	2	1

THE NO. OF SENSOR POINTS/BODY ARRAY (NSPOI) FOLLOWS

		(1)	(2)	(3)
1	1	1	0	1

THE MOM. WHEEL/BODY TABLE (NMOW) FOLLOWS

		(1)	(2)	(3)
1	1	0	0	0
2	1	0	0	0
3	1	0	0	0
4	1	0	0	0
5	1	0	0	0

THE STATE VECTOR LENGTH ARRAY (LENU) FOLLOWS

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	1	6	6	6	0	0	0	15	6

THE STATE VECTOR LOCATION ARRAY (LOCU) FOLLOWS

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	1	1	7	13	19	19	19	19	34

THE SPECIFIED SENSOR POINT/BODY CORRELATION ARRAY (IFTSMW) FOLLOWS

		(1)	(2)
1	1	1	3

ORIGINAL PAGE IS OF POOR QUALITY

SPACELAB - INSIDE OUT GIMBAL CONCEPT
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 154638
THE CPU TIMER = 15 SEC

THE FOLLOWING DATA IS SPECIFIED MOM. WHEEL INFORMATION (IF ANY) AND CONTROLLER INFORMATION

THE SPECIFIED CONTROLLER INITIAL CONDITIONS AND CHARACTERISTICS FOLLOW
(THE FIRST NDELTA ARE INITIAL CONTROLLER STATE VARIABLES, THERE ARE 94 ADDITIONAL CONTROL PARAMETERS)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	41	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	51	0.000	0.000	0.000	0.000	1.865+006	8.396+004	0.000	0.000	0.000	0.000
1	61	0.000	0.000	0.000	0.000	0.000	0.000	6.250+002	6.250+002	6.250+002	1.000+004
1	71	1.000+004	1.000+004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	81	0.000	0.000	0.000	0.000	0.000	0.000	6.343+001	6.343+001	6.343+001	1.015+003
1	91	1.015+003	1.015+003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

SPACELAB - INSIDE OUT GIMBAL CONCEPT
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 054638
THE CPU TIMER = 15 SEC

SUMMARY OF INPUT DATA FOR BODY 1 WHICH IS RIGID.

THE 6X6 INERTIA MATRIX IS ---

		(1)	(2)	(3)	(4)	(5)	(6)
1	1	1.001+006	0.000	0.000	0.000	0.000	0.000
2	1	0.000	7.440+006	0.000	0.000	0.000	0.000
3	1	0.000	0.000	7.650+006	0.000	0.000	0.000
4	1	0.000	0.000	0.000	7.250+004	0.000	0.000
5	1	0.000	0.000	0.000	0.000	7.250+004	0.000
6	1	0.000	0.000	0.000	0.000	0.000	7.250+004

FOR BODY 1 THE P-Q HINGE NO. AND THE EULER ROTATION TYPE APPEAR IN THE FOLLOWING INTEGER ARRAY WHICH IS FOLLOWED BY AN ARRAY CONTAINING EULER ANGLES (1,2,3), AND POSITION VECTOR COMPONENTS (4,5,6) THAT POSITION THE HINGE TRIAD WRT THE BODY TRIAD

		(1)	(2)
1	1	2	1

		(1)	(2)	(3)	(4)	(5)	(6)
1	1	0.000	0.000	0.000	2.200+000	0.000	0.000

FOR BODY 1 THE SENSOR POINT NO. AND THE EULER ROTATION TYPE APPEAR IN THE FOLLOWING INTEGER ARRAY WHICH IS FOLLOWED BY AN ARRAY CONTAINING EULER ANGLES(1,2,3), AND POSITION VECTOR COMPONENTS (4,5,6) THAT POSITION THE SENSOR TRIAD WRT THE BODY TRIAD

		(1)	(2)
1	1	1	1

		(1)	(2)	(3)	(4)	(5)	(6)
1	1	0.000	0.000	0.000	-1.500+001	0.000	0.000

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SPACELAB - INSIDE OUT GIMBAL CONCEPT
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 054639
THE CPU TIMER = 15 SEC

SUMMARY OF INPUT DATA FOR BODY 2 WHICH IS RIGID.

THE 6X6 INERTIA MATRIX IS ---

		(1)	(2)	(3)	(4)	(5)	(6)
1	1	5.000+001	0.000	0.000	0.000	0.000	0.000
2	1	0.000	5.000+001	0.000	0.000	0.000	0.000
3	1	0.000	0.000	5.000+001	0.000	0.000	0.000
4	1	0.000	0.000	0.000	1.950+002	0.000	0.000
5	1	0.000	0.000	0.000	0.000	1.950+002	0.000
6	1	0.000	0.000	0.000	0.000	0.000	1.950+002

FOR BODY 2 THE P-Q HINGE NO. AND THE EULER ROTATION TYPE APPEAR IN THE FOLLOWING INTEGER ARRAY WHICH IS FOLLOWED BY AN ARRAY CONTAINING EULER ANGLES (1,2,3), AND POSITION VECTOR COMPONENTS (4,5,6) THAT POSITION THE HINGE TRIAD WRT THE BODY TRIAD

		(1)	(2)
1	1	2	1
2	1	3	1

		(1)	(2)	(3)	(4)	(5)	(6)
1	1	0.000	0.000	0.000	0.000	0.000	-3.750-001
2	1	0.000	0.000	0.000	0.000	0.000	3.750-001

SPACELAB - INSIDE OUT GIMBAL CONCEPT
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 054639
THE CPU TIMER = 15 SEC

SUMMARY OF INPUT DATA FOR BODY 3 WHICH IS RIGID.

THE 6X6 INERTIA MATRIX IS ---

		(1)	(2)	(3)	(4)	(5)	(6)
1	1	2.263+003	0.000	0.000	0.000	0.000	0.000
2	1	0.000	2.263+003	0.000	0.000	0.000	0.000
3	1	0.000	0.000	2.530+003	0.000	0.000	0.000
4	1	0.000	0.000	0.000	2.380+003	0.000	0.000
5	1	0.000	0.000	0.000	0.000	2.380+003	0.000
6	1	0.000	0.000	0.000	0.000	0.000	2.380+003

FOR BODY 3 THE P-Q HINGE NO. AND THE EULER ROTATION TYPE APPEAR IN THE FOLLOWING INTEGER ARRAY WHICH IS FOLLOWED BY AN ARRAY CONTAINING EULER ANGLES (1,2,3), AND POSITION VECTOR COMPONENTS (4,5,6) THAT POSITION THE HINGE TRIAD WRT THE BODY TRIAD

		(1)	(2)
1	1	3	1

		(1)	(2)	(3)	(4)	(5)	(6)
1	1	0.000	0.000	0.000	0.000	0.000	-1.850+000

FOR BODY 3 THE SENSOR POINT NO. AND THE EULER ROTATION TYPE APPEAR IN THE FOLLOWING INTEGER ARRAY WHICH IS FOLLOWED BY AN ARRAY CONTAINING EULER ANGLES(1,2,3), AND POSITION VECTOR COMPONENTS (4,5,6) THAT POSITION THE SENSOR TRIAD WRT THE BODY TRIAD

		(1)	(2)
1	1	2	1

		(1)	(2)	(3)	(4)	(5)	(6)
1	1	0.000	0.000	0.000	0.000	0.000	0.000

THE FOLLOWING INTEGER ARRAY (INDEP) PRESCRIBES INDEPENDENT VARIABLES (1), AND DEPENDENT VARIABLES (0)
----

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1	1	1	1
1	21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

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SPACELAB - INSIDE OUT GIMBAL CONCEPT
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 054642
THE CPU TIMER = 16 SEC

AT SIMULATION TIME, T = 0.0000 •

THE STATE VECTOR Y =

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	31	0.000	1.047+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

AT SIMULATION TIME, T = 0.0000 •

THE STATE VECTOR TIME DERIVATIVE YDT =

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.314-003	0.000	-4.027-004
1	11	0.000	-9.115-005	0.000	-6.155-005	0.000	1.003-005	0.000	3.231-005	0.000	0.000
1	21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	31	0.000	0.000	0.000	0.000	9.513-002	0.000	0.000	5.100-008	0.000	

AT SIMULATION TIME, T = 0.0000 •

THE BETAS (EULER ANGLES, POSITION COORDINATES) ARE

		(1)	(2)	(3)
1	1	0.000	0.000	0.000
2	1	0.000	0.000	1.047+000
3	1	0.000	0.000	0.000
4	1	0.000	0.000	0.000
5	1	0.000	0.000	0.000
6	1	0.000	0.000	0.000

AT SIMULATION TIME, T = 0.0000 •

THE BETA TIME DERIVATIVES ARE

		(1)	(2)	(3)
1	1	0.000	0.000	0.000
2	1	0.000	0.000	0.000
3	1	0.000	0.000	0.000
4	1	0.000	0.000	0.000
5	1	0.000	0.000	0.000
6	1	0.000	0.000	0.000

AT SIMULATION TIME, T = 0.0000 •

THE DELTAS (CONTROL SYSTEM VARIABLES) ARE

		(1)	(2)	(3)	(4)	(5)	(6)
1	1	0.000	0.000	0.000	0.000	0.000	0.000

AT SIMULATION TIME, T = 0.0000 •

THE DELTA TIME DERIVATIVES ARE

(1)	(2)	(3)	(4)	(5)	(6)

```
  1   1    0.000        9.513-002  0.000        0.000        5.100-008  0.000

          AT SIMULATION TIME, T = 0.0000      * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
  FOR BODY  1   THE VELOCITIES ARE
                  ( 1)         ( 2)         ( 3)         ( 4)         ( 5)         ( 6)
  1    1       0.000        0.000        0.000        0.000        0.000        0.000
  FOR BODY  1   THE CORRESPONDING MOMENTA ARE
                  ( 1)         ( 2)         ( 3)         ( 4)         ( 5)         ( 6)
  1    1       0.000        0.000        0.000        0.000        0.000        0.000
  FOR BODY  1   ITS CONTRIBUTION TO TOTAL ANGULAR AND LINEAR MOMENTUM IS
                  ( 1)         ( 2)         ( 3)         ( 4)         ( 5)         ( 6)
  1    1       0.000        0.000        0.000        0.000        0.000        0.000
  ITS CONTRIBUTION TO TOTAL KINETIC AND POTENTIAL ENERGIES IS      0.00000000      0.00000000

          AT SIMULATION TIME, T = 0.0000      * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
  FOR BODY  2   THE VELOCITIES ARE
                  ( 1)         ( 2)         ( 3)         ( 4)         ( 5)         ( 6)
  1    1       0.000        0.000        0.000        0.000        0.000        0.000
  FOR BODY  2   THE CORRESPONDING MOMENTA ARE
                  ( 1)         ( 2)         ( 3)         ( 4)         ( 5)         ( 6)
  1    1       0.000        0.000        0.000        0.000        0.000        0.000
  FOR BODY  2   ITS CONTRIBUTION TO TOTAL ANGULAR AND LINEAR MOMENTUM IS
                  ( 1)         ( 2)         ( 3)         ( 4)         ( 5)         ( 6)
  1    1       0.000        0.000        0.000        0.000        0.000        0.000
  ITS CONTRIBUTION TO TOTAL KINETIC AND POTENTIAL ENERGIES IS      0.00000000      0.00000000

          AT SIMULATION TIME, T = 0.0000      * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
  FOR BODY  3   THE VELOCITIES ARE
                  ( 1)         ( 2)         ( 3)         ( 4)         ( 5)         ( 6)
  1    1       0.000        0.000        0.000        0.000        0.000        0.000
  FOR BODY  3   THE CORRESPONDING MOMENTA ARE
                  ( 1)         ( 2)         ( 3)         ( 4)         ( 5)         ( 6)
  1    1       0.000        0.000        0.000        0.000        0.000        0.000
  FOR BODY  3   ITS CONTRIBUTION TO TOTAL ANGULAR AND LINEAR MOMENTUM IS
                  ( 1)         ( 2)         ( 3)         ( 4)         ( 5)         ( 6)
  1    1       0.000        0.000        0.000        0.000        0.000        0.000
  ITS CONTRIBUTION TO TOTAL KINETIC AND POTENTIAL ENERGIES IS      0.00000000      0.00000000

          AT SIMULATION TIME, T = 0.0000      * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
  THE INTERCONNECTION CONSTRAINT FORCES(LAMBDAS) ARE
                  ( 1)         ( 2)         ( 3)
  1    1       7.853-002    0.000        1.777-002

          AT SIMULATION TIME, T = 0.0000      * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
  THE TOTAL ANGULAR MOMENTUM VECTOR IS
                  ( 1)         ( 2)         ( 3)
  1    1       0.000        0.000        0.000
  THE TOTAL LINEAR MOMENTUM VECTOR IS
                  ( 1)         ( 2)         ( 3)
  1    1       0.000        0.000        0.000
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
THE TOTAL ANGULAR MOMENTUM =  0.00000000
THE TOTAL LINEAR MOMENTUM  =  0.00000000
THE TOTAL KINETIC ENERGY   =  0.00000000
THE TOTAL POTENTIAL ENERGY =  0.50000000
THE TOTAL ENERGY (T + V)   =  0.50000000
```

SPACELAB - INSIDE OUT GIMBAL CONCEPT
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 054825
THE CPU TIMER = 60 SEC

AT SIMULATION TIME, T = 2.0000+000* *

THE STATE VECTOR Y =

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	0.000	8.182-005	0.000	-1.782-005	0.000	5.345-004	0.000	3.654-004	0.000	3.736-004
1	11	0.000	6.135-004	0.000	-9.068-007	0.000	-2.772-004	0.000	7.492-004	0.000	1.195-004
1	21	0.000	-1.476-005	0.000	7.969-004	0.000	4.926-004	0.000	-1.120-005	0.000	-3.169-005
1	31	0.000	1.047+000	0.000	0.000	1.222+000	0.000	0.000	6.507-007	0.000	

AT SIMULATION TIME, T = 2.0000+000* *

THE STATE VECTOR TIME DERIVATIVE YDT =

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	0.000	5.983-008	0.000	1.978-006	0.000	-7.493-007	0.000	-1.079-004	0.000	-1.986-005
1	11	0.000	2.138-005	0.000	1.172-007	0.000	-4.821-005	0.000	-4.141-005	0.000	8.182-005
1	21	0.000	-1.775-005	0.000	5.345-004	0.000	2.836-004	0.000	2.547-004	0.000	2.589-004
1	31	0.000	-3.663-004	0.000	0.000	2.120-001	0.000	0.000	1.545-007	0.000	

AT SIMULATION TIME, T = 2.0000+000* *

THE BETAS (EULER ANGLES, POSITION COORDINATES) ARE

		(1)	(2)	(3)
1	1	0.000	0.000	0.000
2	1	1.195-004	4.926-004	1.047+000
3	1	0.000	0.000	0.000
4	1	-1.476-005	-1.120-005	0.000
5	1	0.000	0.000	0.000
6	1	7.969-004	-3.169-005	0.000

AT SIMULATION TIME, T = 2.0000+000* *

THE BETA TIME DERIVATIVES ARE

		(1)	(2)	(3)
1	1	0.000	0.000	0.000
2	1	8.182-005	2.836-004	-3.663-004
3	1	0.000	0.000	0.000
4	1	-1.775-005	2.547-004	0.000
5	1	0.000	0.000	0.000
6	1	5.345-004	2.589-004	0.000

AT SIMULATION TIME, T = 2.0000+000* *

THE DELTAS (CONTROL SYSTEM VARIABLES) ARE

		(1)	(2)	(3)	(4)	(5)	(6)
1	1	0.000	1.222+000	0.000	0.000	6.507-007	0.000

AT SIMULATION TIME, T = 2.0000+000* *

THE DELTA TIME DERIVATIVES ARE

(1) (2) (3) (4) (5) (6)

```
   1    1    0.000       2.120-001  0.000       0.000       1.545-007  0.000

        AT SIMULATION TIME, T = 2.0000+000* * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
FOR BODY  1   THE VELOCITIES ARE
               ( 1)       ( 2)       ( 3)       ( 4)       ( 5)       ( 6)
   1    1    0.000       8.182-005  0.000     -1.782-005  0.000       5.345-004
FOR BODY  1   THE CORRESPONDING MOMENTA ARE
               ( 1)       ( 2)       ( 3)       ( 4)       ( 5)       ( 6)
   1    1    0.000       6.087+002  0.000     -1.292+000  0.000       3.875+001
FOR BODY  1   ITS CONTRIBUTION TO TOTAL ANGULAR AND LINEAR MOMENTUM IS
               ( 1)       ( 2)       ( 3)       ( 4)       ( 5)       ( 6)
   1    1    0.000       6.087+002  0.000     -1.287+000  0.000       3.875+001
ITS CONTRIBUTION TO TOTAL KINETIC AND POTENTIAL ENERGIES IS      3.52721084-002 0.00000000

        AT SIMULATION TIME, T = 2.0000+000* * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
FOR BODY  2   THE VELOCITIES ARE
               ( 1)       ( 2)       ( 3)       ( 4)       ( 5)       ( 6)
   1    1    0.000       3.654-004  0.000      3.736-004  0.000       6.135-004
FOR BODY  2   THE CORRESPONDING MOMENTA ARE
               ( 1)       ( 2)       ( 3)       ( 4)       ( 5)       ( 6)
   1    1    0.000       1.827-002  0.000      7.286-002  0.000       1.196-001
FOR BODY  2   ITS CONTRIBUTION TO TOTAL ANGULAR AND LINEAR MOMENTUM IS
               ( 1)       ( 2)       ( 3)       ( 4)       ( 5)       ( 6)
   1    1    0.000      -2.175-001  0.000      7.293-002  0.000       1.196-001
ITS CONTRIBUTION TO TOTAL KINETIC AND POTENTIAL ENERGIES IS      5.36477057-005 0.00000000

        AT SIMULATION TIME, T = 2.0000+000* * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
FOR BODY  3   THE VELOCITIES ARE
               ( 1)       ( 2)       ( 3)       ( 4)       ( 5)       ( 6)
   1    1    0.000      -9.068-007  0.000     -2.772-004  0.000       7.492-004
FOR BODY  3   THE CORRESPONDING MOMENTA ARE
               ( 1)       ( 2)       ( 3)       ( 4)       ( 5)       ( 6)
   1    1    0.000      -2.052-003  0.000     -6.597-001  0.000       1.783+000
FOR BODY  3   ITS CONTRIBUTION TO TOTAL ANGULAR AND LINEAR MOMENTUM IS
               ( 1)       ( 2)       ( 3)       ( 4)       ( 5)       ( 6)
   1    1    0.000      -3.530+000  0.000      1.214+000  0.000       1.463+000
ITS CONTRIBUTION TO TOTAL KINETIC AND POTENTIAL ENERGIES IS      7.59346646-004 0.00000000

        AT SIMULATION TIME, T = 2.0000+000* * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
THE INTERCONNECTION CONSTRAINT FORCES(LAMBDAS) ARE
               ( 1)       ( 2)       ( 3)
   1    1   -1.428-001  0.000       5.000-002

        AT SIMULATION TIME, T = 2.0000+000* * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
THE TOTAL ANGULAR MOMENTUM VECTOR IS
               ( 1)       ( 2)       ( 3)
   1    1    0.000       6.050+002  0.000
THE TOTAL LINEAR MOMENTUM VECTOR IS .
               ( 1)       ( 2)       ( 3)
   1    1    3.514-004  0.000       4.033+001
```

```
THE TOTAL ANGULAR MOMENTUM =  6.05600007+002
THE TOTAL LINEAR MOMENTUM  =  4.03333333+001
THE TOTAL KINETIC ENERGY   =  3.60851028-002
THE TOTAL POTENTIAL ENERGY =  3.49423090-001
THE TOTAL ENERGY (T + V)   =  3.85508193-001

                    CPU TIME/STEP   CPU TIME/REAL TIME
                      4.0000-01          2.0000+01
```

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VI-18

SPACELAB - INSIDE OUT GIMBAL CONCEPT
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 054957
THE CPU TIMER = 103 SEC

AT SIMULATION TIME, T = 4.0000+000* *

THE STATE VECTOR Y =

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	0.000	1.184-006	0.000	1.977-005	0.000	2.231-005	0.000	-2.840-004	0.000	-4.616-004
1	11	0.000	-3.673-004	0.000	1.330-006	0.000	3.616-005	0.000	-6.757-004	0.000	1.680-004
1	21	0.000	-1.215-005	0.000	1.118-003	0.000	3.157-004	0.000	2.019-006	0.000	-1.051-005
1	31	0.000	1.047+000	0.000	0.000	-1.623-001	0.000	0.000	-9.252-008	0.000	

AT SIMULATION TIME, T = 4.0000+000* *

THE STATE VECTOR TIME DERIVATIVE YDT =

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	0.000	1.713-007	0.000	-4.971-006	0.000	-6.866-006	0.000	-5.283-005	0.000	1.590-004
1	11	0.000	1.919-004	0.000	-1.048-006	0.000	-9.829-005	0.000	2.166-004	0.000	1.184-006
1	21	0.000	1.978-005	0.000	2.230-005	0.000	-2.852-004	0.000	-3.750-004	0.000	-3.869-004
1	31	0.000	2.854-004	0.000	0.000	4.351-001	0.000	0.000	1.734-007	0.000	

AT SIMULATION TIME, T = 4.0000+000* *

THE BETAS (EULER ANGLES, POSITION COORDINATES) ARE

		(1)	(2)	(3)
1	1	0.000	0.000	0.000
2	1	1.680-004	3.157-004	1.047+000
3	1	0.000	0.000	0.000
4	1	-1.215-005	2.019-006	0.000
5	1	0.000	0.000	0.000
6	1	1.118-003	-1.051-005	0.000

AT SIMULATION TIME, T = 4.0000+000* *

THE BETA TIME DERIVATIVES ARE

		(1)	(2)	(3)
1	1	0.000	0.000	0.000
2	1	1.184-006	-2.852-004	2.854-004
3	1	0.000	0.000	0.000
4	1	1.978-005	-3.750-004	0.000
5	1	0.000	0.000	0.000
6	1	2.230-005	-3.869-004	0.000

AT SIMULATION TIME, T = 4.0000+000* *

THE DELTAS (CONTROL SYSTEM VARIABLES) ARE

		(1)	(2)	(3)	(4)	(5)	(6)
1	1	0.000	-1.623-001	0.000	0.000	-9.252-008	0.000

AT SIMULATION TIME, T = 4.0000+000* *

THE DELTA TIME DERIVATIVES ARE

(1)	(2)	(3)	(4)	(5)	(6)

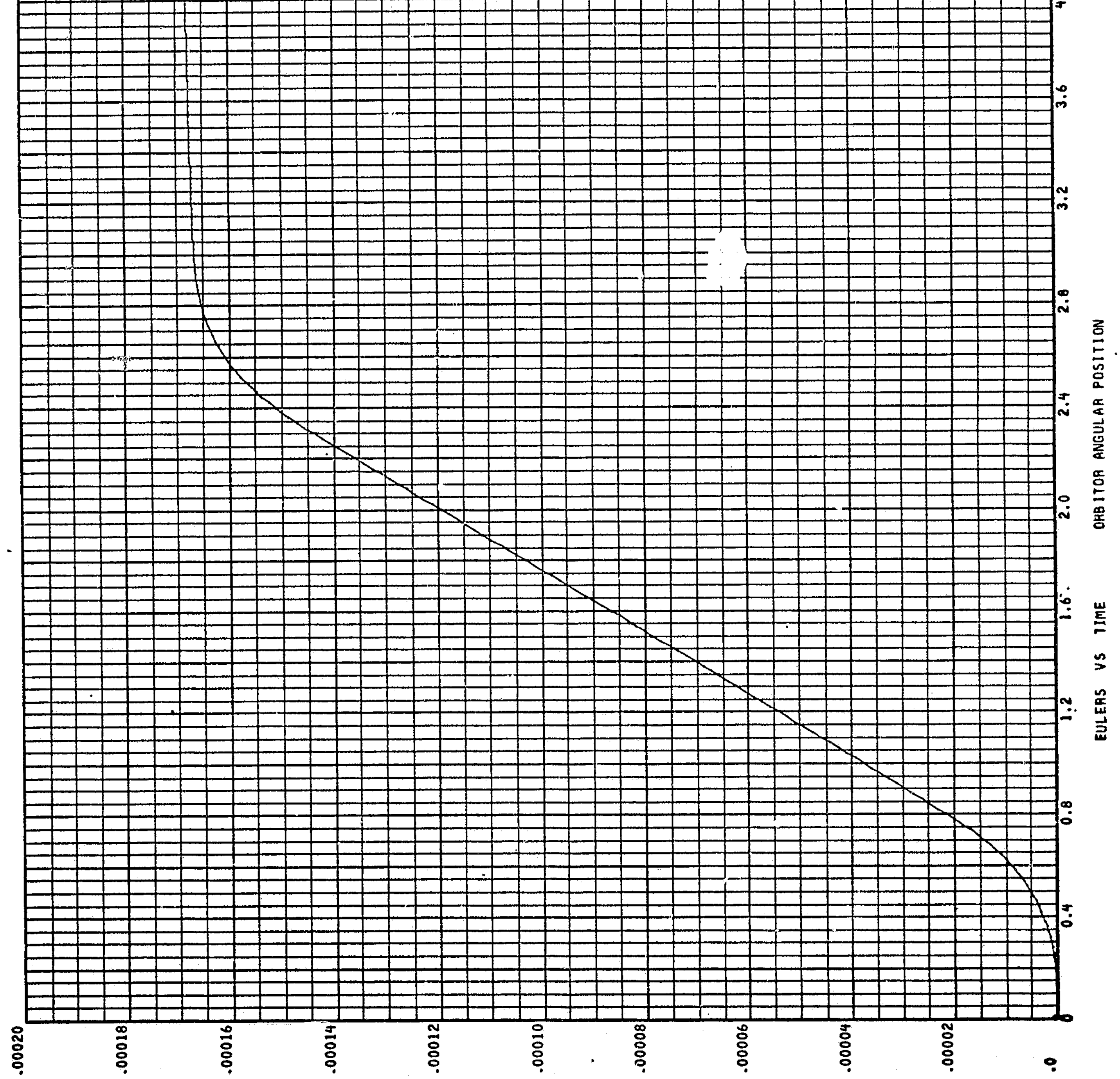
```
  1    1     0.000       4.351-001   0.000        0.000       1.734-007   0.000

      AT SIMULATION TIME, T = 4.0000+000* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
FOR BODY  1    THE VELOCITIES ARE
                 ( 1)        ( 2)        ( 3)        ( 4)        ( 5)        ( 6)
  1    1     0.000       1.184-006   0.000       1.977-005   0.000       2.231-005
FOR BODY  1    THE CORRESPONDING MOMENTA ARE
                 ( 1)        ( 2)        ( 3)        ( 4)        ( 5)        ( 6)
  1    1     0.000       8.806+000   0.000       1.433+000   0.000       1.617+000
FOR BODY  1    ITS CONTRIBUTION TO TOTAL ANGULAR AND LINEAR MOMENTUM IS
                 ( 1)        ( 2)        ( 3)        ( 4)        ( 5)        ( 6)
  1    1     0.000       8.807+000   0.000       1.434+000   0.000       1.617+000
ITS CONTRIBUTION TO TOTAL KINETIC AND POTENTIAL ENERGIES IS       3.74182646-005 0.00000000

      AT SIMULATION TIME, T = 4.0000+000* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
FOR BODY  2    THE VELOCITIES ARE
                 ( 1)        ( 2)        ( 3)        ( 4)        ( 5)        ( 6)
  1    1     0.000      -2.840-004   0.000      -4.616-004   0.000      -3.673-004
FOR BODY  2    THE CORRESPONDING MOMENTA ARE
                 ( 1)        ( 2)        ( 3)        ( 4)        ( 5)        ( 6)
  1    1     0.000      -1.420-002   0.000      -9.001-002   0.000      -7.163-002
FOR BODY  2    ITS CONTRIBUTION TO TOTAL ANGULAR AND LINEAR MOMENTUM IS
                 ( 1)        ( 2)        ( 3)        ( 4)        ( 5)        ( 6)
  1    1     0.000       1.095-001   0.000      -9.005-002   0.000      -7.158-002
ITS CONTRIBUTION TO TOTAL KINETIC AND POTENTIAL ENERGIES IS       3.59456721-005 0.00000000

      AT SIMULATION TIME, T = 4.0000+000* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
FOR BODY  3    THE VELOCITIES ARE
                 ( 1)        ( 2)        ( 3)        ( 4)        ( 5)        ( 6)
  1    1     0.000       1.330-006   0.000       3.618-005   0.000      -6.757-004
FOR BODY  3    THE CORRESPONDING MOMENTA ARE
                 ( 1)        ( 2)        ( 3)        ( 4)        ( 5)        ( 6)
  1    1     0.000       3.010-003   0.000       8.610-002   0.000      -1.608+000
FOR BODY  3    ITS CONTRIBUTION TO TOTAL ANGULAR AND LINEAR MOMENTUM IS
                 ( 1)        ( 2)        ( 3)        ( 4)        ( 5)        ( 6)
  1    1     0.000       1.082+000   0.000      -1.350+000   0.000      -8.786-001
ITS CONTRIBUTION TO TOTAL KINETIC AND POTENTIAL ENERGIES IS       5.44827183-004 0.00000000

      AT SIMULATION TIME, T = 4.0000+000* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
THE INTERCONNECTION CONSTRAINT FORCES(LAMBDAS) ARE
                 ( 1)        ( 2)        ( 3)
  1    1     3.292-001   0.000       4.605-001

      AT SIMULATION TIME, T = 4.0000+000* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
THE TOTAL ANGULAR MOMENTUM VECTOR IS
                 ( 1)        ( 2)        ( 3)
  1    1     0.000       9.999+000   0.000
THE TOTAL LINEAR MOMENTUM VECTOR IS
                 ( 1)        ( 2)        ( 3)
  1    1    -5.897-003   0.000       6.667-001
```

```
THE TOTAL ANGULAR MOMENTUM =  9.99908390+000
THE TOTAL LINEAR MOMENTUM  =  6.66693237-001
THE TOTAL KINETIC ENERGY   =  6.18191120-004
THE TOTAL POTENTIAL ENERGY =  2.18189380-001
THE TOTAL ENERGY (T + V)   =  2.18807571-001

                        CPU TIME/STEP  CPU TIME/REAL TIME
                          4.0000-01          2.0000+01
```

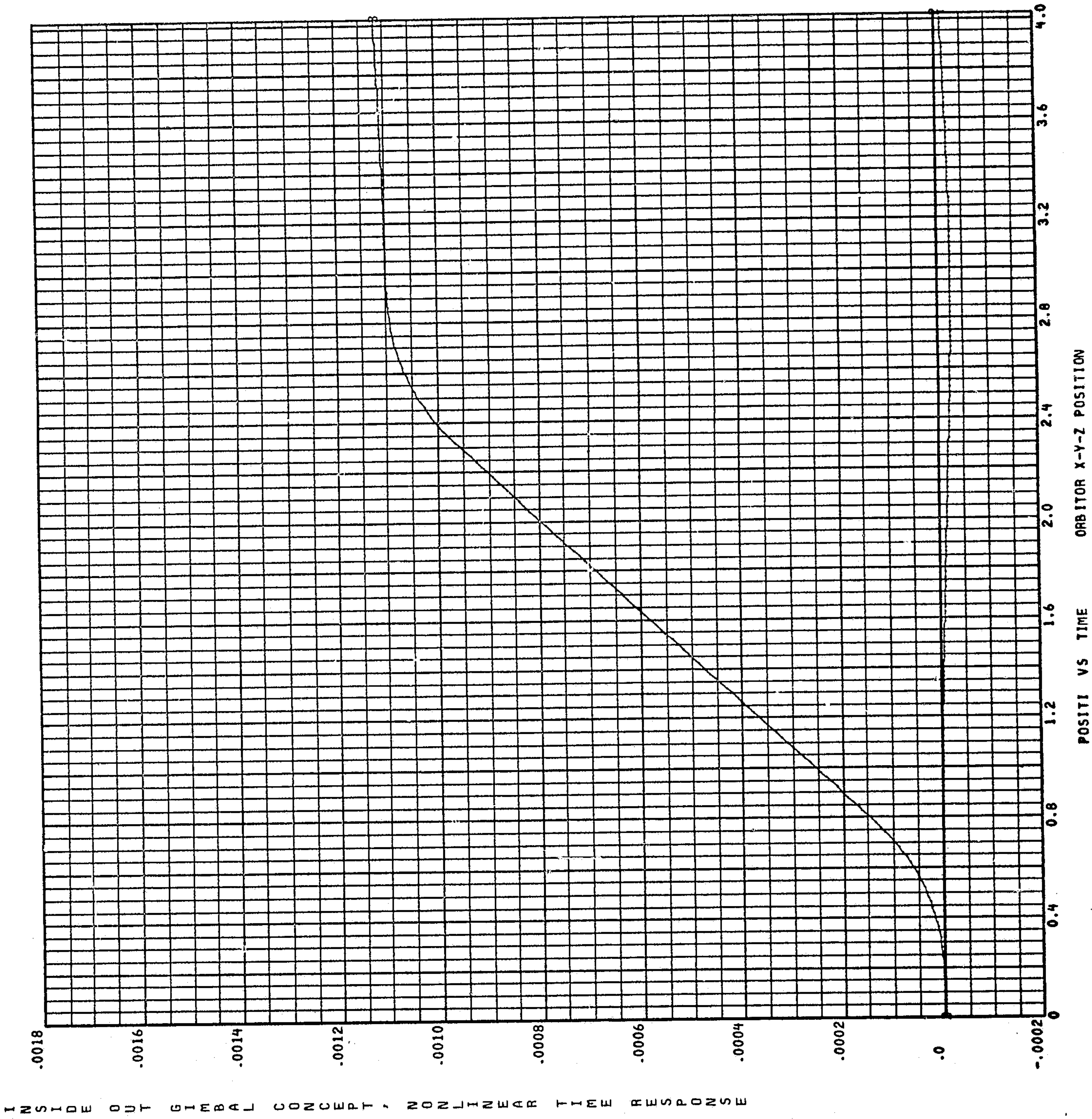
```
SPACELAB - INSIDE OUT GIMBAL CONCEPT                                  CURRENT TIME = 055001
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT                             THE CPU TIMER =  104 SEC

                    SUMMARY OF PLOTTING INFORMATION

INSIDE OUT GIMBAL CONCEPT, NONLINEAR TIME RESPONSE TO CREW M

NSET     =    2
NRPLOT   =  202          NCPLOT    =  135
KRPLOT   = 1000          KCPLOT    =   16

ISET   =   1
JVPL   =   1  20  21  22  23  24  25  26  27  28  29  30  31  32  33  34

     NCI    =   1    NCD   =   2   3   4     NGRID =   1
     TIME       EULERS     ORBITOR ANGULAR POSITION

     NCI    =   1    NCD   =   5   6   7     NGRID =   1
     TIME       POSITI     ORBITOR X-Y-Z POSITION

     NCI    =   1    NCD   =   8   9  10     NGRID =   1
     TIME       ANGLE      MOUNT/ORBITOR ANGULAR POSITION

     NCI    =   1    NCD   =  11  12  13     NGRID =   1
     TIME       POSIT      MOUNT/ORBITOR X-Y-Z RELATIVE POSITION

     NCI    =   1    NCD   =  14  15  16     NGRID =   1
     TIME       ANGLE      IOG GIMBAL ANGLES

ISET   =   2
JVPL   =   1  74  75  76  77  78  79  80  81  82 131 132 133 134 135

     NCI    =   1    NCD   =   2   3   4     NGRID =   1
     TIME       TORQUE     GIMBAL TORQUES

     NCI    =   1    NCD   =   5   6   7     NGRID =   1
     TIME       DELTAP     ATTITUDE ERRORS

     NCI    =   1    NCD   =   8   9  10     NGRID =   1
     TIME       FORCE      GIMBAL X-Y-Z LAMBDAS
```

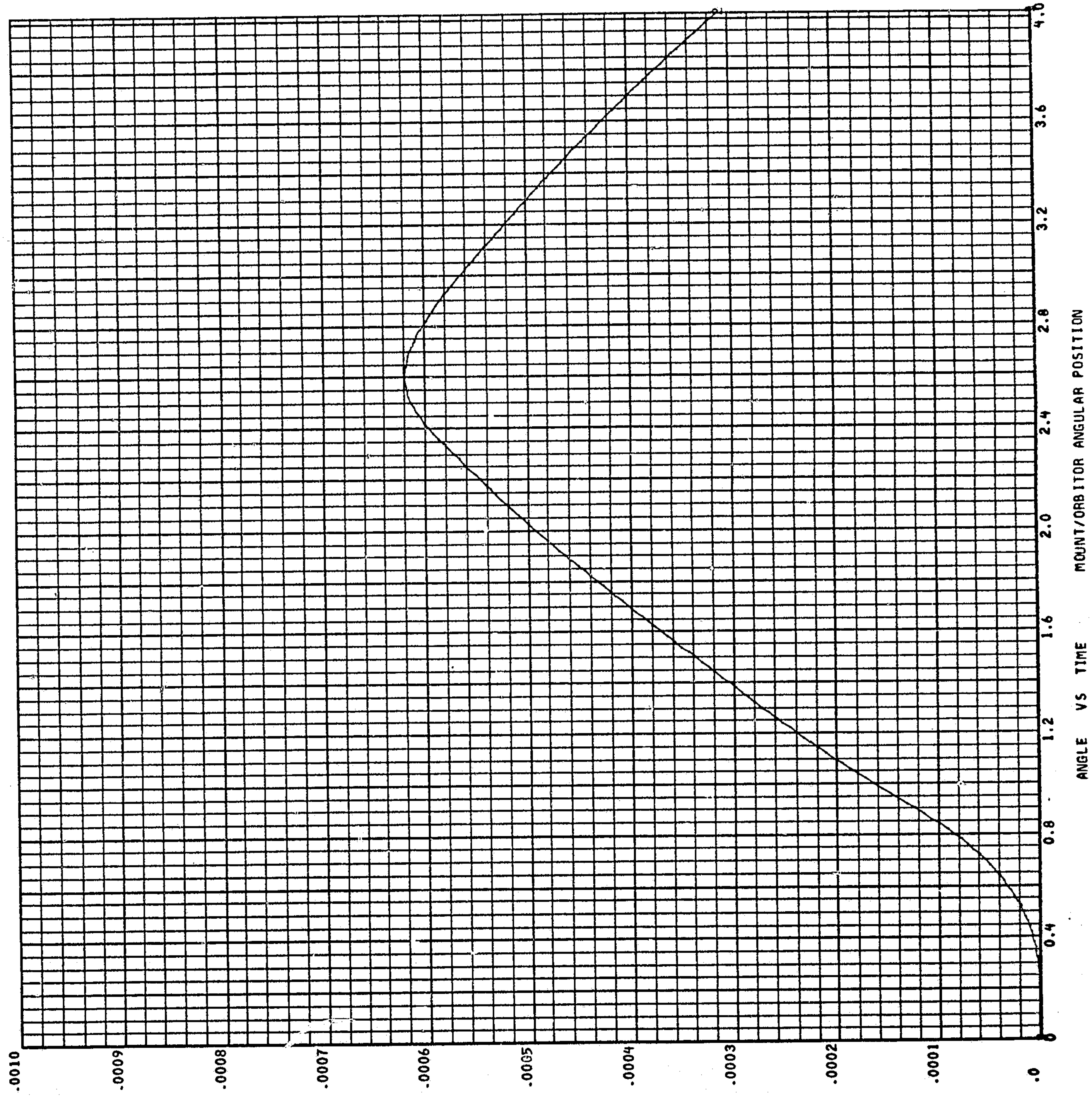
```
NCI   =   1    NCD   =  11   12   0    NGRID =   1
TIME      MOMENT    ANGULAR/LINEAR MOMENTUM

NCI   =   1    NCD   =  13   14   15   NGRID =   1
TIME      ENERGY    KINETIC, POTENTIAL AND TOTAL ENERGY
```

END OF INPUT DATA HAS BEEN REACHED.

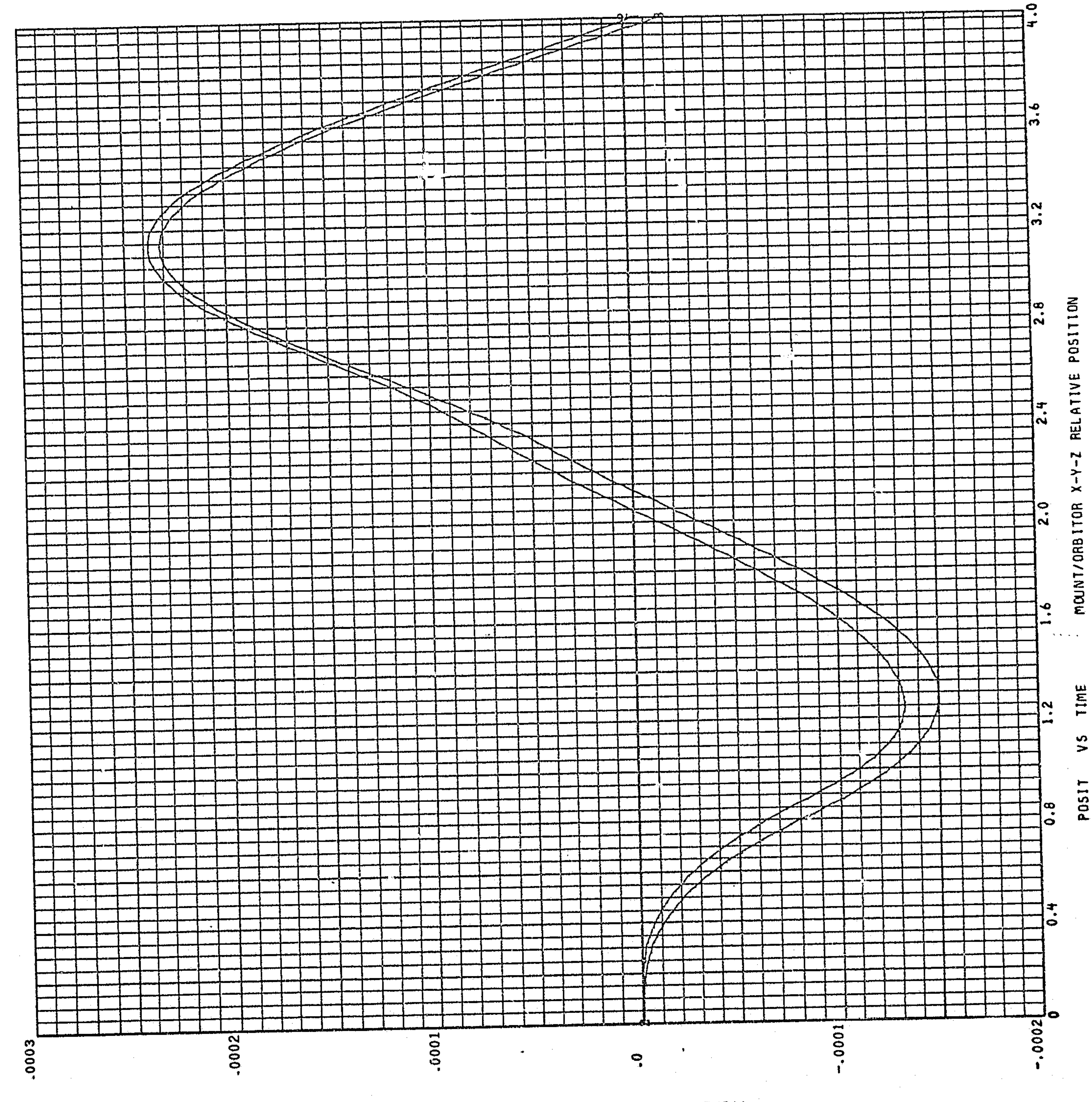


INSIDE OUT GIMBAL CONCEPT, NONLINEAR TIME RESPONSE

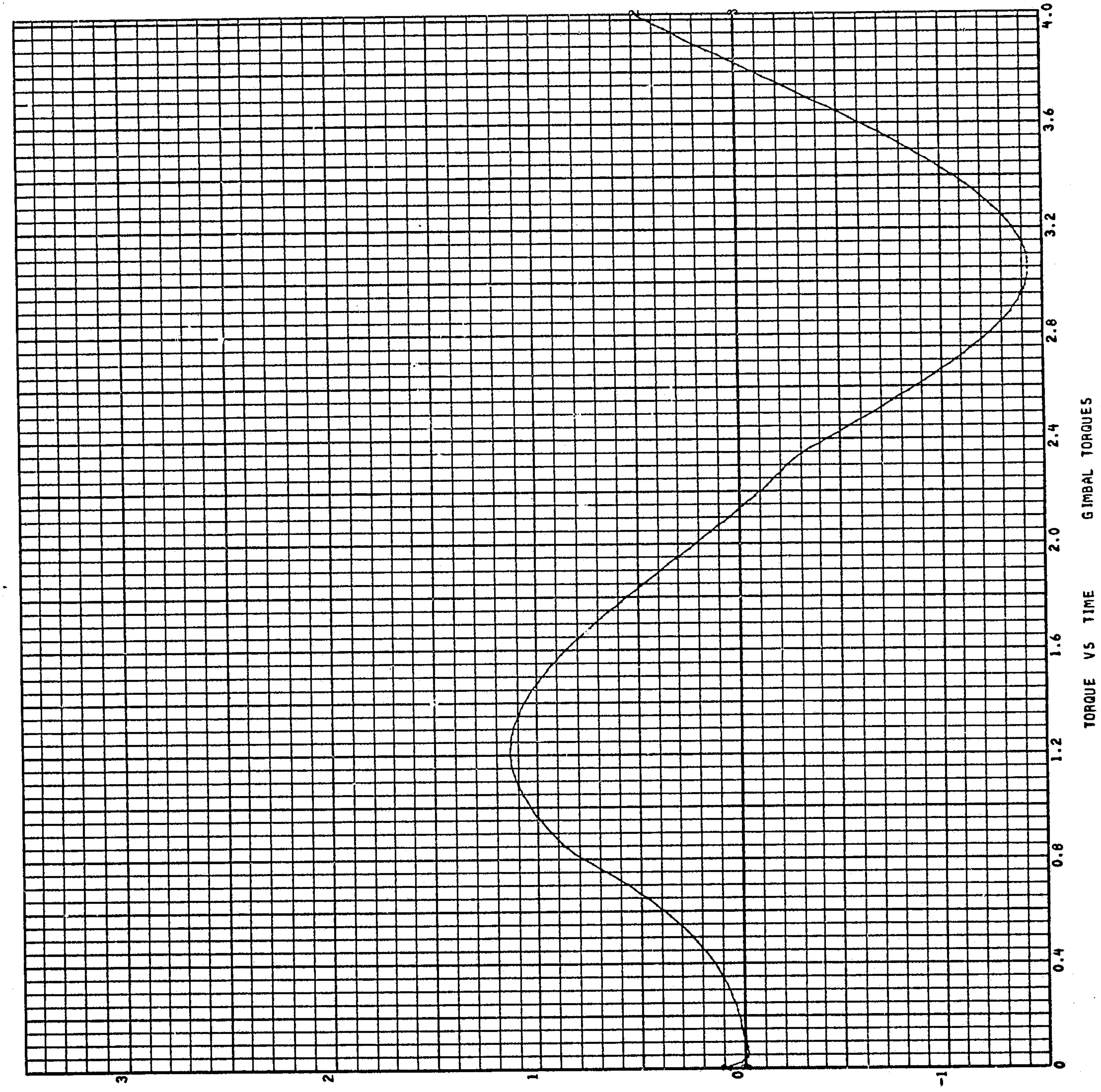

ORBITOR X-Y-Z POSITION
POSITI VS TIME
0
0.4
0.8
1.2
1.6
2.0
2.4
2.8
3.2
3.6
4.0
.0018
.0016
.0014
.0012
.0010
.0008
.0006
.0004
.0002
.0
-.0002
INSIDE OUT GIMBAL CONCEPT, NONLINEAR TIME RESPONSE



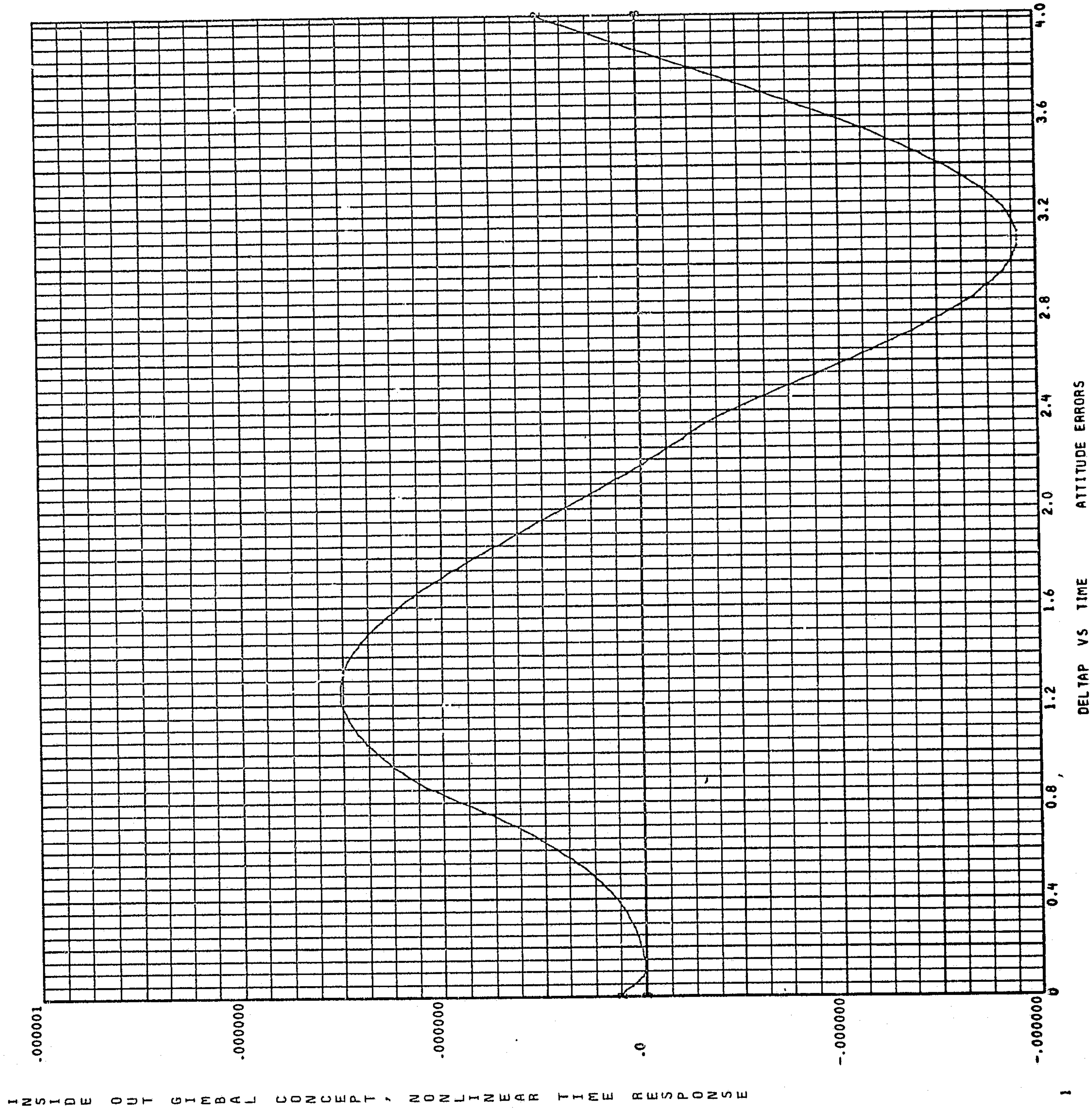
INSIDE OUT GIMBAL CONCEPT, NONLINEAR TIME RESPONSE



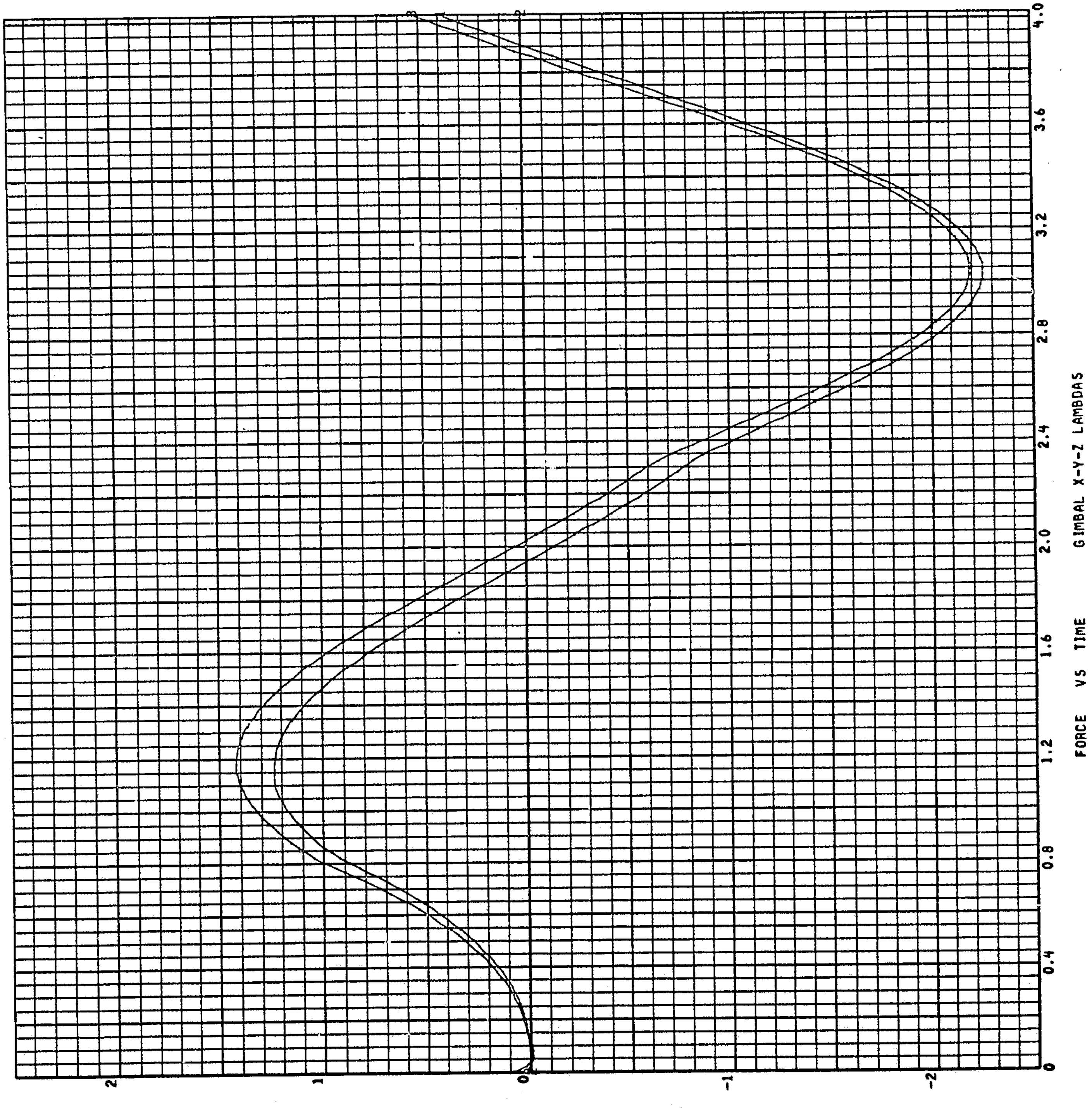
INSIDE OUT GIMBAL CONCEPT, NONLINEAR TIME RESPONSE



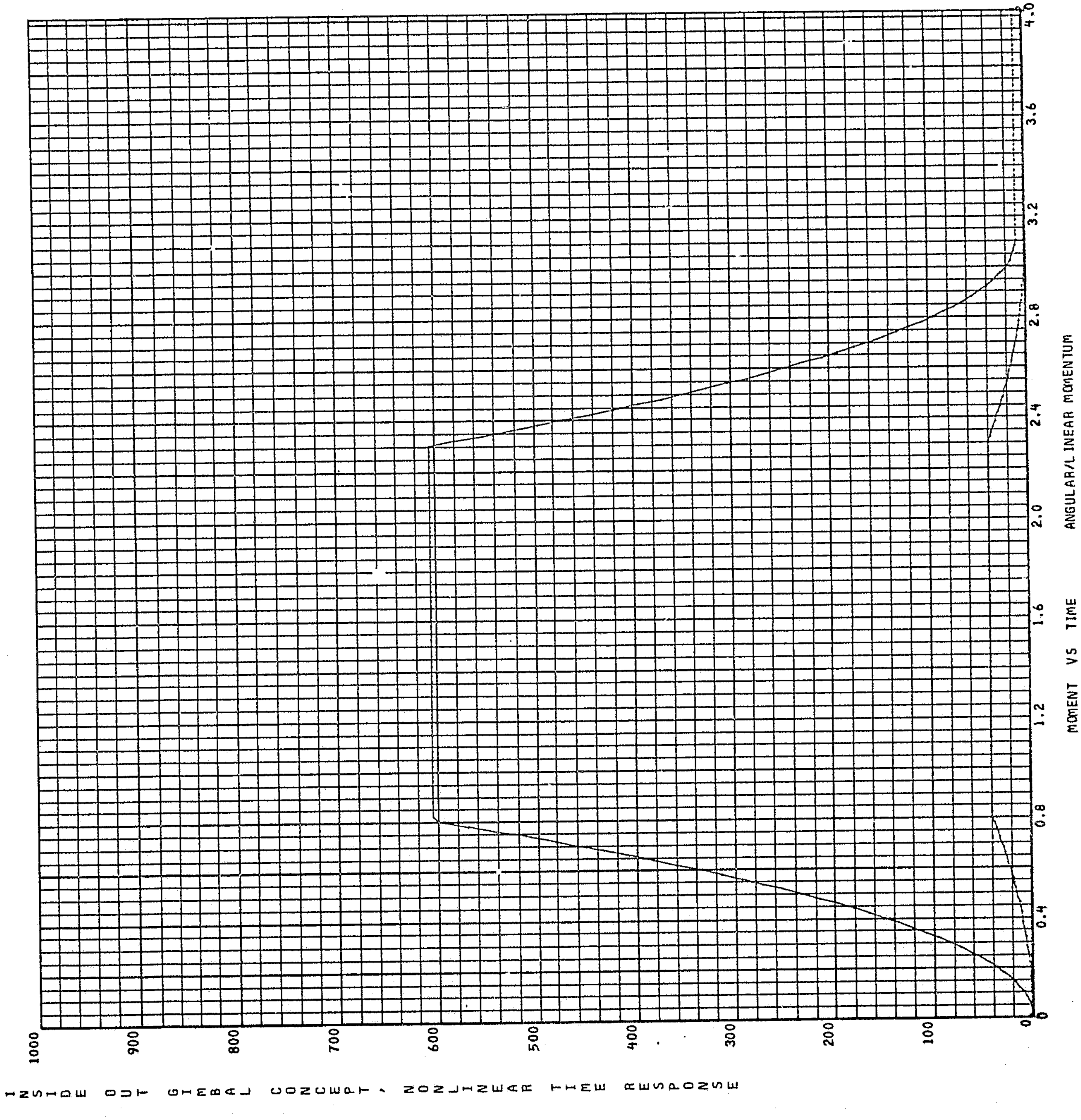
INSIDE OUT GIMBAL CONCEPT, NONLINEAR TIME RESPONSE

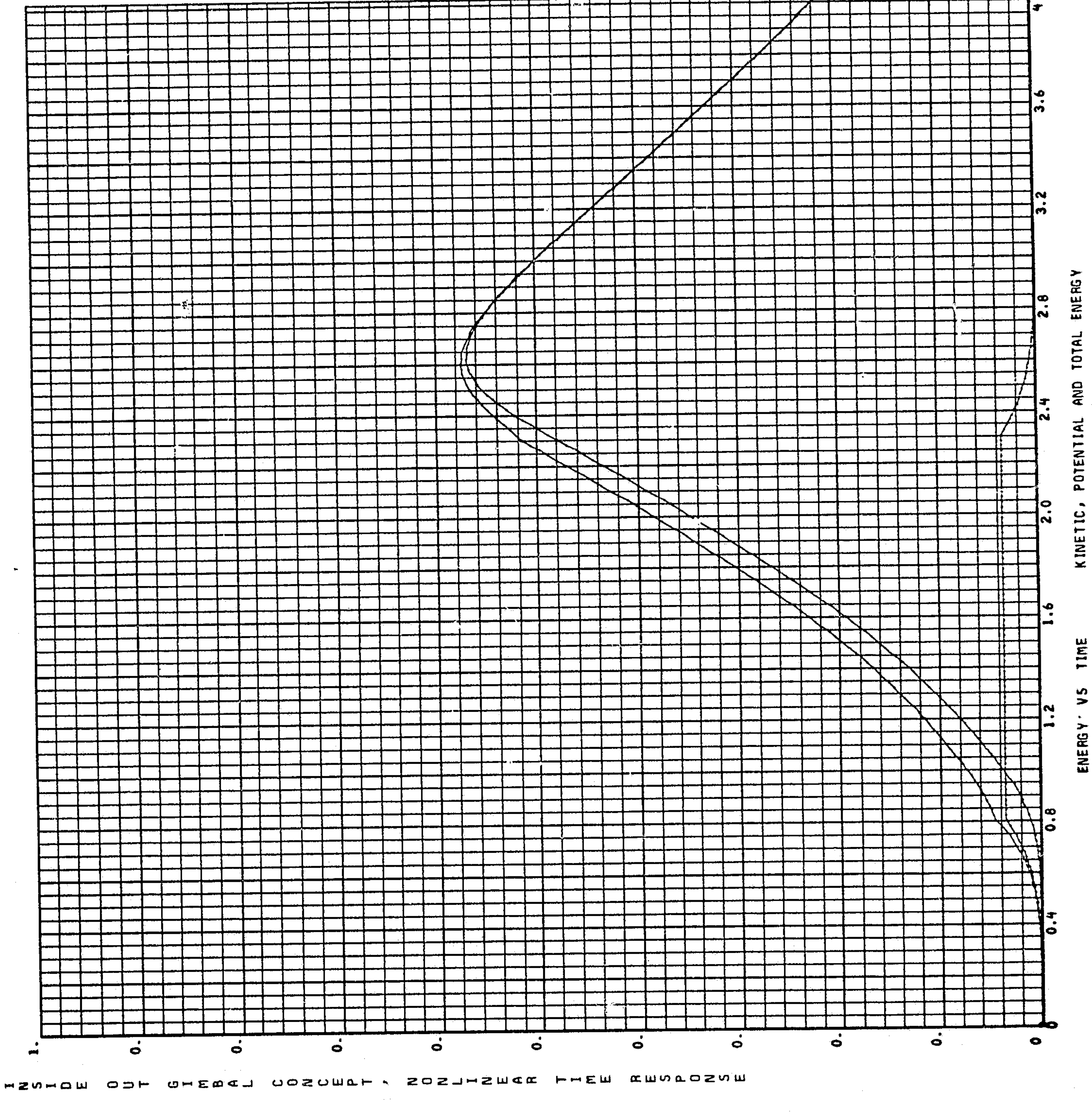


DELTAP VS TIME ATTITUDE ERRORS
0
0.4
0.8
1.2
1.6
2.0
2.4
2.8
3.2
3.6
4.0
.000001
.000000
.000000
.0
-.000000
-.000000
INSIDE OUT GIMBAL CONCEPT, NONLINEAR TIME RESPONSE
1



INSIDE OUT GIMBAL CONCEPT, NONLINEAR TIME RESPONSE


INSIDE OUT GIMBAL CONCEPT, NONLINEAR TIME RESPONSE
MOMENT VS TIME
ANGULAR/LINEAR MOMENTUM
0
100
200
300
400
500
600
700
800
900
1000
0
0.4
0.8
1.2
1.6
2.0
2.4
2.8
3.2
3.6
4.0


ENERGY VS TIME KINETIC, POTENTIAL AND TOTAL ENERGY
0
0.4
0.8
1.2
1.6
2.0
2.4
2.8
3.2
3.6
4.0
1.
0.
INSIDE OUT GIMBAL CONCEPT, NONLINEAR TIME RESPONSE

B. THE SPACELAB INSIDE-OUT GIMBAL CONCEPT - FREQUENCY RESPONSE SIMULATION

The second demonstration problem (IOG-2) considers the same three-body, three-hinge configuration as the first. The geometry, inertial properties, spring/damper data and gimbal torque laws are exactly the same. However, IOG-2 considers the frequency domain rather than time.

The equations of motion are numerically linearized and a similarity transformation performed such that new linearized states are introduced (sensor motion and control torques). For this equivalent mechanical system, a variety of transfer functions are produced and evaluated.

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084908
THE CPU TIMER = 20 SEC

SUMMARY OF DYNAMIC-SIMULATION-PROGRAM INPUT DATA . . . .

ACTUAL SIZES		MAXIMUM SIZES		INTEGRATION DATA		GRAVITY GRADIENT DATA				MISC. DATA	
NB	3	NBMAX	5	STARTT	0.000	G1	0.000	GAMA1	0.000	NOPRNT	1
NH	3	NHMAX	5	DELTAT	1.500-002	G2	0.000	GAMA2	0.000	NOPLOT	0
NSPT	2	NSPMAX	10	ENDT	5.000-001	G3	0.000	GAMA3	0.000	IFLNER	1
NOFMO	0	NMWMAX	5			GMAG	0.000	RCMAG	0.000		
NDELTA	2	NMWBOD	3								
NU	18	NMDBOD	6								
NBETA	15	KMU	15								
NLAM	3	KY	250								
NEQ	35	KU	65								

THE TOPOLOGY ARRAY (ITOPOL) FOR THIS CASE FOLLOWS

		(1)	(2)	(3)
1	1	1	2	3
2	1	0	1	2

THE CONSTRAINT SPECIFICATIONS FOR THIS CASE FOLLOW

		(1)	(2)	(3)
1	1	12	12	12
2	1	0	0	0
3	1	0	0	0
4	1	0	0	0
5	1	0	0	1
6	1	0	0	1
7	1	0	0	1

THE SPECIFIED INITIAL HINGE ANGLES AND DISPLACEMENTS (BETAH) FOLLOW

		(1)	(2)	(3)
1	1	0.000	0.000	0.000
2	1	0.000	0.000	1.047+000
3	1	0.000	0.000	0.000
4	1	0.000	0.000	0.000
5	1	0.000	0.000	0.000
6	1	0.000	0.000	0.000

THE SPECIFIED INITIAL HINGE RATES (BETAHD) FOLLOW

		(1)	(2)	(3)
1	1	0.000	0.000	0.000
2	1	0.000	0.000	0.000
3	1	0.000	0.000	0.000
4	1	0.000	0.000	0.000
5	1	0.000	0.000	0.000

ORIGINAL PAGE IS
OF POOR QUALITY

VI-36

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084908
THE CPU TIMER = 21 SEC

THE NO. OF ELASTIC MODES/BODY ARRAY (IRGFLX) FOLLOWS

		(1)	(2)	(3)
1	1	0	0	0

THE NO. OF P/Q HINGE POINTS/BODY ARRAY (NHPOI) FOLLOWS

		(1)	(2)	(3)
1	1	1	2	1

THE NO. OF SENSOR POINTS/BODY ARRAY (NSPOI) FOLLOWS

		(1)	(2)	(3)
1	1	1	0	1

THE MOM. WHEEL/BODY TABLE (NNOW) FOLLOWS

		(1)	(2)	(3)
1	1	0	0	0
2	1	0	0	0
3	1	0	0	0
4	1	0	0	0
5	1	0	0	0

THE STATE VECTOR LENGTH ARRAY (LENU) FOLLOWS

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	1	6	6	6	0	0	0	15	2

THE STATE VECTOR LOCATION ARRAY (LOCU) FOLLOWS

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	1	1	7	13	19	19	19	19	34

THE SPECIFIED SENSOR POINT/BODY CORRELATION ARRAY (IFTSMW) FOLLOWS

		(1)	(2)
1	1	1	3

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084909
THE CPU TIMER = 21 SEC

THE FOLLOWING DATA IS SPECIFIED MOM. WHEEL INFORMATION (IF ANY) AND CONTROLLER INFORMATION

THE SPECIFIED CONTROLLER INITIAL CONDITIONS AND CHARACTERISTICS FOLLOW
(THE FIRST NDELTA ARE INITIAL CONTROLLER STATE VARIABLES, THERE ARE 98 ADDITIONAL CONTROL PARAMETERS)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	41	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	51	0.000	0.000	0.000	0.000	1.865+006	8.396+004	0.000	0.000	0.000	0.000
1	61	0.000	0.000	0.000	0.000	0.000	0.000	6.250+002	6.250+002	6.250+002	1.000+004
1	71	1.000+004	1.000+004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	81	0.000	0.000	0.000	0.000	0.000	0.000	6.343+001	6.343+001	6.343+001	1.015+003
1	91	1.015+003	1.015+003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

ORIGINAL PAGE IS
OF POOR QUALITY

VI-38

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084909
THE CPU TIMER = 21 SEC

SUMMARY OF INPUT DATA FOR BODY 1 WHICH IS RIGID.

THE 6X6 INERTIA MATRIX IS ---

		(1)	(2)	(3)	(4)	(5)	(6)
1	1	1.001+006	0.000	0.000	0.000	0.000	0.000
2	1	0.000	7.440+006	0.000	0.000	0.000	0.000
3	1	0.000	0.000	7.650+006	0.000	0.000	0.000
4	1	0.000	0.000	0.000	7.250+004	0.000	0.000
5	1	0.000	0.000	0.000	0.000	7.250+004	0.000
6	1	0.000	0.000	0.000	0.000	0.000	7.250+004

FOR BODY 1 THE P-O HINGE NO. AND THE EULER ROTATION TYPE APPEAR IN THE FOLLOWING INTEGER ARRAY WHICH IS FOLLOWED BY AN ARRAY CONTAINING EULER ANGLES (1,2,3), AND POSITION VECTOR COMPONENTS (4,5,6) THAT POSITION THE HINGE TRIAD WRT THE BODY TRIAD

		(1)	(2)
1	1	2	1

		(1)	(2)	(3)	(4)	(5)	(6)
1	1	0.000	0.000	0.000	2.200+000	0.000	0.000

FOR BODY 1 THE SENSOR POINT NO. AND THE EULER ROTATION TYPE APPEAR IN THE FOLLOWING INTEGER ARRAY WHICH IS FOLLOWED BY AN ARRAY CONTAINING EULER ANGLES(1,2,3), AND POSITION VECTOR COMPONENTS (4,5,6) THAT POSITION THE SENSOR TRIAD WRT THE BODY TRIAD

		(1)	(2)
1	1	1	1

		(1)	(2)	(3)	(4)	(5)	(6)
1	1	0.000	0.000	0.000	-1.500+001	0.000	0.000

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084909
THE CPU TIMER = 21 SEC

SUMMARY OF INPUT DATA FOR BODY 2 WHICH IS RIGID.

THE 6X6 INERTIA MATRIX IS ---

		(1)	(2)	(3)	(4)	(5)	(6)
1	1	5.000+001	0.000	0.000	0.000	0.000	0.000
2	1	0.000	5.000+001	0.000	0.000	0.000	0.000
3	1	0.000	0.000	5.000+001	0.000	0.000	0.000
4	1	0.000	0.000	0.000	1.950+002	0.000	0.000
5	1	0.000	0.000	0.000	0.000	1.950+002	0.000
6	1	0.000	0.000	0.000	0.000	0.000	1.950+002

FOR BODY 2 THE P-Q HINGE NO. AND THE EULER ROTATION TYPE APPEAR IN THE FOLLOWING INTEGER ARRAY WHICH IS FOLLOWED BY AN ARRAY CONTAINING EULER ANGLES (1,2,3), AND POSITION VECTOR COMPONENTS (4,5,6) THAT POSITION THE HINGE TRIAD WRT THE BODY TRIAD

		(1)	(2)
1	1	2	1
2	1	3	1

		(1)	(2)	(3)	(4)	(5)	(6)
1	1	0.000	0.000	0.000	0.000	0.000	-3.750-001
2	1	0.000	0.000	0.000	0.000	0.000	3.750-001

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084909
THE CPU TIMER = 21 SEC

SUMMARY OF INPUT DATA FOR BODY 3 WHICH IS RIGID.

THE 6X6 INERTIA MATRIX IS ---

		(1)	(2)	(3)	(4)	(5)	(6)
1	1	2.263+003	0.000	0.000	0.000	0.000	0.000
2	1	0.000	2.263+003	0.000	0.000	0.000	0.000
3	1	0.000	0.000	2.530+003	0.000	0.000	0.000
4	1	0.000	0.000	0.000	2.380+003	0.000	0.000
5	1	0.000	0.000	0.000	0.000	2.380+003	0.000
6	1	0.000	0.000	0.000	0.000	0.000	2.380+003

FOR BODY 3 THE P-Q HINGE NO. AND THE EULER ROTATION TYPE APPEAR IN THE FOLLOWING INTEGER ARRAY WHICH IS FOLLOWED BY AN ARRAY CONTAINING EULER ANGLES (1,2,3), AND POSITION VECTOR COMPONENTS (4,5,6) THAT POSITION THE HINGE TRIAD WRT THE BODY TRIAD

		(1)	(2)
1	1	3	1

		(1)	(2)	(3)	(4)	(5)	(6)
1	1	0.000	0.000	0.000	0.000	0.000	-1.850+000

FOR BODY 3 THE SENSOR POINT NO. AND THE EULER ROTATION TYPE APPEAR IN THE FOLLOWING INTEGER ARRAY WHICH IS FOLLOWED BY AN ARRAY CONTAINING EULER ANGLES(1,2,3), AND POSITION VECTOR COMPONENTS (4,5,6) THAT POSITION THE SENSOR TRIAD WRT THE BODY TRIAD

		(1)	(2)
1	1	2	1

		(1)	(2)	(3)	(4)	(5)	(6)
1	1	0.000	0.000	0.000	0.000	0.000	0.000

THE FOLLOWING INTEGER ARRAY (INDEP) PRESCRIBES INDEPENDENT VARIABLES (1), AND DEPENDENT VARIABLES (0)
----

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	1	1	1	1
1	21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1					

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN) CURRENT TIME = 084910
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT THE CPU TIMER = 21 SEC

AT SIMULATION TIME, T = 0.0000

THE STATE VECTOR Y =

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	31	0.000	1.047+000	0.000	0.000	0.000					

AT SIMULATION TIME, T = 0.0000

THE STATE VECTOR TIME DERIVATIVE YDT =

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	31	0.000	0.000	0.000	0.000	0.000					

AT SIMULATION TIME, T = 0.0000

THE BETAS (EULER ANGLES, POSITION COORDINATES) ARE

		(1)	(2)	(3)
1	1	0.000	0.000	0.000
2	1	0.000	0.000	1.047+000
3	1	0.000	0.000	0.000
4	1	0.000	0.000	0.000
5	1	0.000	0.000	0.000
6	1	0.000	0.000	0.000

ORIGINAL PAGE IS OF POOR QUALITY

AT SIMULATION TIME, T = 0.0000

THE BETA TIME DERIVATIVES ARE

		(1)	(2)	(3)
1	1	0.000	0.000	0.000
2	1	0.000	0.000	0.000
3	1	0.000	0.000	0.000
4	1	0.000	0.000	0.000
5	1	0.000	0.000	0.000
6	1	0.000	0.000	0.000

AT SIMULATION TIME, T = 0.0000

THE DELTAS (CONTROL SYSTEM VARIABLES) ARE

		(1)	(2)
1	1	0.000	0.000

AT SIMULATION TIME, T = 0.0000

THE DELTA TIME DERIVATIVES ARE

(1) (2)

```
   1    1    0.000       0.000

       AT SIMULATION TIME, T = 0.0000     * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
 FOR BODY  1   THE VELOCITIES ARE
                (1)         (2)         (3)         (4)         (5)         (6)
   1    1    0.000       0.000       0.000       0.000       0.000       0.000
 FOR BODY  1   THE CORRESPONDING MOMENTA ARE
                (1)         (2)         (3)         (4)         (5)         (6)
   1    1    0.000       0.000       0.000       0.000       0.000       0.000
 FOR BODY  1   ITS CONTRIBUTION TO TOTAL ANGULAR AND LINEAR MOMENTUM IS
                (1)         (2)         (3)         (4)         (5)         (6)
   1    1    0.000       0.000       0.000       0.000       0.000       0.000
 ITS CONTRIBUTION TO TOTAL KINETIC AND POTENTIAL ENERGIES IS      0.00000000      0.00000000

       AT SIMULATION TIME, T = 0.0000     * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
 FOR BODY  2   THE VELOCITIES ARE
                (1)         (2)         (3)         (4)         (5)         (6)
   1    1    0.000       0.000       0.000       0.000       0.000       0.000
 FOR BODY  2   THE CORRESPONDING MOMENTA ARE
                (1)         (2)         (3)         (4)         (5)         (6)
   1    1    0.000       0.000       0.000       0.000       0.000       0.000
 FOR BODY  2   ITS CONTRIBUTION TO TOTAL ANGULAR AND LINEAR MOMENTUM IS
                (1)         (2)         (3)         (4)         (5)         (6)
   1    1    0.000       0.000       0.000       0.000       0.000       0.000
 ITS CONTRIBUTION TO TOTAL KINETIC AND POTENTIAL ENERGIES IS      0.00000000      0.00000000

       AT SIMULATION TIME, T = 0.0000     * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
 FOR BODY  3   THE VELOCITIES ARE
                (1)         (2)         (3)         (4)         (5)         (6)
   1    1    0.000       0.000       0.000       0.000       0.000       0.000
 FOR BODY  3   THE CORRESPONDING MOMENTA ARE
                (1)         (2)         (3)         (4)         (5)         (6)
   1    1    0.000       0.000       0.000       0.000       0.000       0.000
 FOR BODY  3   ITS CONTRIBUTION TO TOTAL ANGULAR AND LINEAR MOMENTUM IS
                (1)         (2)         (3)         (4)         (5)         (6)
   1    1    0.000       0.000       0.000       0.000       0.000       0.000
 ITS CONTRIBUTION TO TOTAL KINETIC AND POTENTIAL ENERGIES IS      0.00000000      0.00000000

       AT SIMULATION TIME, T = 0.0000     * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
 THE INTERCONNECTION CONSTRAINT FORCES(LAMBDAS) ARE
                (1)         (2)         (3)
   1    1    0.000       0.000       0.000

       AT SIMULATION TIME, T = 0.0000     * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
 THE TOTAL ANGULAR MOMENTUM VECTOR IS
                (1)         (2)         (3)
   1    1    0.000       0.000       0.000
 THE TOTAL LINEAR MOMENTUM VECTOR IS
                (1)         (2)         (3)
   1    1    0.000       0.000       0.000
```

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THE TOTAL ANGULAR MOMENTUM =  0.00000000
THE TOTAL LINEAR MOMENTUM  =  0.00000000
THE TOTAL KINETIC ENERGY   =  0.00000000
THE TOTAL POTENTIAL ENERGY =  2.42582265-009
THE TOTAL ENERGY (T + V)   =  2.42582265-009
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VI-44

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084924
THE CPU TIMER = 32 SEC

OUTPUT MATRIX -A- (40 X 32)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	-6.337-005	0.000	0.000	0.000	0.000	0.000	6.337-005	0.000	0.000	0.000
1	21	0.000	0.000	0.000	6.244-004	0.000	0.000	0.000	0.000	0.000	0.000
2	1	0.000	-6.687-004	0.000	0.000	0.000	3.001-004	0.000	8.526-006	0.000	0.000
2	11	-3.001-004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	21	0.000	0.000	8.401-005	0.000	0.000	0.000	-2.957-003	0.000	0.000	0.000
2	31	0.000	2.016-006								
3	1	0.000	0.000	-6.504-004	0.000	-2.919-004	0.000	1.094-004	0.000	8.292-006	2.919-004
3	21	0.000	8.170-005	0.000	0.000	0.000	2.876-003	0.000	0.000	0.000	0.000
4	1	0.000	0.000	0.000	-1.400-002	0.000	0.000	0.000	-1.050-002	0.000	0.000
4	11	-8.082-003	0.000	0.000	0.000	1.616-002	0.000	0.000	0.000	0.000	0.000
4	21	0.000	0.000	0.000	0.000	1.379-001	0.000	0.000	0.000	0.000	0.000
5	1	0.000	0.000	-3.680-002	0.000	-1.400-002	0.000	5.250-003	0.000	0.000	1.400-002
5	21	0.000	0.000	0.000	0.000	0.000	1.379-001	0.000	0.000	0.000	0.000
6	1	0.000	3.680-002	0.000	0.000	0.000	-1.400-002	0.000	0.000	0.000	0.000
6	11	1.400-002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	21	0.000	0.000	0.000	0.000	0.000	0.000	1.379-001	0.000	0.000	0.000
6	31	0.000	1.379-005								
7	1	9.072-001	0.000	2.067+001	0.000	9.397+000	0.000	-5.018+002	0.000	0.000	1.317+003
7	11	0.000	8.410+003	0.000	-1.326+003	0.000	4.621+004	0.000	1.891+005	0.000	0.000
7	21	0.000	4.621+004	0.000	1.891+005	0.000	-9.259+001	0.000	4.621+004	0.000	5.452+004
8	1	0.000	1.827+000	0.000	-9.644+000	0.000	-4.410-001	0.000	-8.090+000	0.000	0.000
8	11	7.185+002	0.000	6.267+002	0.000	-3.507+002	0.000	2.576+004	9.151-006	0.000	0.000
8	21	0.000	0.000	2.575+004	9.151-006	9.502+001	0.000	4.345+000	0.000	2.576+004	0.000
9	1	0.000	0.000	1.269+000	0.000	0.000	0.000	0.000	0.000	-1.269+000	0.000
9	11	0.000	3.358+003	0.000	0.000	0.000	3.731+004	0.000	6.462+004	0.000	0.000
9	21	0.000	3.729+004	0.000	6.462+004	0.000	0.000	0.000	3.731+004	0.000	0.000
10	1	2.471-001	0.000	8.765+000	0.000	3.984+000	0.000	-1.271+002	0.000	0.000	3.303+002
10	11	0.000	2.204+003	0.000	-3.343+002	0.000	1.259+004	0.000	4.928+004	0.000	0.000
10	21	0.000	1.259+004	0.000	4.928+004	0.000	-3.925+001	0.000	1.259+004	0.000	1.374+004
11	1	0.000	-2.626+000	0.000	-1.362-001	0.000	1.181+000	0.000	-7.455-002	0.000	0.000
11	11	-5.147+001	0.000	-4.348+001	0.000	2.526+001	0.000	-1.787+003	-6.349-007	0.000	0.000
11	21	0.000	0.000	-1.787+003	-6.349-007	1.342+000	0.000	-1.164+001	0.000	-1.787+003	0.000
12	1	0.000	0.000	0.000	0.000	0.000	0.000	1.165+001	0.000	0.000	-3.107+001

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084924
THE CPU TIMER = 32 SEC

OUTPUT MATRIX -A- (40 X 32) CONTINUED

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
12	11	0.000	-2.323+002	0.000	3.107+001	0.000	-1.475+003	0.000	-5.108+003	0.000	0.000
12	21	0.000	-1.475+003	0.000	-5.108+003	0.000	0.000	0.000	-1.475+003	0.000	-1.277+003
13	1	0.000	6.105-001	0.000	4.726-002	0.000	-2.731-001	0.000	2.588-002	0.000	0.000
13	11	5.825+000	0.000	4.785+000	0.000	-2.817+000	0.000	1.967+002	6.987-008	0.000	0.000
13	21	0.000	0.000	1.966+002	6.987-008	-4.656-001	0.000	2.691+000	0.000	1.967+002	0.000
14	1	-2.025-002	0.000	2.200-001	0.000	1.000-001	0.000	1.025+001	0.000	0.000	-2.749+001
14	11	0.000	-1.806+002	0.000	2.739+001	0.000	-1.031+003	0.000	-4.038+003	0.000	0.000
14	21	0.000	-1.031+003	0.000	-4.037+003	0.000	-9.855-001	0.000	-1.031+003	0.000	-1.126+003
15	1	0.000	-3.886-001	0.000	1.042-001	0.000	1.862-001	0.000	5.704-002	0.000	0.000
15	11	1.767+001	0.000	1.541+001	0.000	-9.019+000	0.000	6.335+002	2.251-007	0.000	0.000
15	21	0.000	0.000	6.333+002	2.251-007	-1.026+000	0.000	-1.835+000	0.000	6.335+002	0.000
16	1	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	1	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	1	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	1	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000
20	1	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000
21	1	0.000	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000
22	1	0.000	0.000	-1.000+000	0.000	0.000	0.000	0.000	0.000	1.000+000	0.000
23	1	0.000	-1.000+000	0.000	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000
24	1	-1.000+000	0.000	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000
25	1	0.000	0.000	0.000	-1.000+000	0.000	0.000	0.000	-7.500-001	0.000	0.000
25	11	-5.774-001	0.000	0.000	0.000	1.155+000	0.000	0.000	0.000	0.000	0.000
26	1	0.000	0.000	-2.200+000	0.000	-1.000+000	0.000	3.750-001	0.000	0.000	1.000+000
27	1	0.000	2.200+000	0.000	0.000	0.000	-1.000+000	0.000	0.000	0.000	0.000
27	11	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	1	0.000	0.000	0.000	0.000	0.000	0.000	-1.732+000	0.000	-1.000+000	0.000
28	11	0.000	2.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

VI-46

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084924
THE CPU TIMER = 33 SEC

OUTPUT MATRIX -A- (40 X 32) CONTINUED

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
29	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-1.000+000	0.000	0.000
29	11	6.242-001	0.000	5.405-001	0.000	-3.121-001	0.000	0.000	0.000	0.000	0.000
30	1	0.000	0.000	0.000	0.000	0.000	0.000	-2.203+000	0.000	0.000	5.405-001
30	11	0.000	1.732+000	0.000	-5.405-001	0.000	0.000	0.000	0.000	0.000	0.000
31	11	6.242-001	0.000	5.405-001	0.000	-3.121-001	0.000	0.000	0.000	0.000	0.000
32	31	1.000+000	0.000								
33	1	0.000	0.000	0.000	0.000	0.000	0.000	-2.027-001	0.000	0.000	5.405-001
33	11	0.000	0.000	0.000	-5.405-001	0.000	0.000	0.000	0.000	0.000	0.000
34	11	6.242-001	0.000	5.405-001	0.000	-3.121-001	0.000	0.000	0.000	0.000	0.000
35	11	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
36	11	0.000	0.000	0.000	0.000	0.000	1.000+000	0.000	1.732+000	0.000	0.000
36	21	0.000	1.000+000	0.000	1.732+000	0.000	0.000	0.000	1.000+000	0.000	0.000
37	11	0.000	0.000	0.000	0.000	0.000	0.000	1.000+000	3.553-010	0.000	0.000
37	21	0.000	0.000	1.000+000	3.553-010	0.000	0.000	0.000	0.000	1.000+000	0.000
38	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.000+000	0.000	0.000
38	21	0.000	0.000	0.000	2.000+000	0.000	0.000	0.000	0.000	0.000	1.000+000
39	1	0.000	1.500+001	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000
40	31	0.000	1.000+000								

END OF WRITE.

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084927
THE CPU TIMER = 34 SEC

OUTPUT MATRIX -T- (32 X 32)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	1	0.000	0.000	0.000	0.000	-6.667-002	0.000	0.000	0.000	0.000	0.000
2	31	6.667-002	0.000								
3	1	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	1	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	1	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000
6	1	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000
7	1	0.000	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000
8	1	0.000	0.000	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000
9	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000
10	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000+000	0.000
11	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-8.660-001
11	11	5.000-001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	21	0.000	0.000	0.000	0.000	0.000	1.602+000	0.000	0.000	0.000	0.000
12	21	0.000	0.000	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000
13	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000+000
14	1	0.000	0.000	0.000	0.000	0.000	-3.750-001	0.000	0.000	1.000+000	0.000
14	21	0.000	0.000	0.000	0.000	-1.850+000	0.000	0.000	0.000	0.000	0.000
15	11	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	11	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	11	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	11	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000
19	11	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000
20	11	0.000	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084927
THE CPU TIMER = 35 SEC

OUTPUT MATRIX -T- (32 X 32) CONTINUED

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
21	11	0.000	0.000	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000
22	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000
23	11	0.000	0.000	-1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	21	0.000	-1.000+000	1.776-010	0.000	0.000	0.000	0.000	-2.019-028	1.000+000	-1.776-010
24	11	0.000	0.000	0.000	-1.000+000	0.000	0.000	0.000	0.000	0.000	0.000
24	21	0.000	0.000	-5.000-001	0.000	0.000	0.000	0.000	8.674-019	0.000	5.000-001
25	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000+000	0.000
26	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000+000
27	21	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	11	0.000	-1.000+000	0.000	0.000	0.000	0.000	0.000	-1.000+000	0.000	0.000
28	21	0.000	0.000	8.660-001	0.000	0.000	0.000	0.000	1.000+000	0.000	-8.660-001
29	21	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	21	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
31	21	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000
32	31	0.000	1.000+000								

END OF WRITE.

RUN NO. IOG 2 DATE 091275 PAGE NO. 13

RUN BY

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN) CURRENT TIME = 084929

SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT THE CPU TIMER = 36 SEC

OUTPUT MATRIX Y. (1 X 32)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	31	0.000	1.047+000								

END OF WRITE.

ORIGINAL PAGE IS OF POOR QUALITY

VI-50

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IGS/INSTRUMENT

CURRENT TIME = 084932
THE CPU TIMER = 37 SEC

OUTPUT MATRIX -A*- (32 X 32)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	-6.337-005	0.000	0.000	0.000	0.000	6.337-005	0.000	0.000	0.000	0.000
1	11	0.000	0.000	0.000	-6.244-004	0.000	0.000	0.000	0.000	0.000	0.000
1	21	0.000	0.000	-3.122-004	0.000	0.000	0.000	5.416-022	0.000	3.122-004	0.000
2	1	0.000	-6.504-004	0.000	-2.919-004	0.000	1.094-004	0.000	8.292-006	2.919-004	0.000
2	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.170-005	0.000	2.876-003
3	1	0.000	0.000	-1.400-002	0.000	0.000	0.000	-1.050-002	0.000	0.000	7.000-003
3	11	1.212-002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.379-001	0.000
3	21	0.000	0.000	0.000	0.000	-1.295-002	0.000	0.000	0.000	0.000	0.000
4	1	0.000	-3.080-002	0.000	-1.400-002	0.000	5.250-003	0.000	0.000	1.400-002	0.000
4	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.379-001
5	1	0.000	0.000	0.000	0.000	-1.605-002	0.000	0.000	0.000	0.000	-1.212-002
5	11	7.000-003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	21	1.379-001	0.000	0.000	0.000	2.243-002	0.000	0.000	0.000	0.000	2.053-003
5	31	0.000	1.379-005								
6	1	9.072-001	2.067+001	0.000	9.397+000	0.000	-4.431+000	0.000	0.000	-9.397+000	0.000
6	11	0.000	-2.888-007	0.000	8.939+000	0.000	0.000	0.000	-2.888-007	0.000	-9.259+001
6	21	0.000	0.000	4.470+000	2.454+003	0.000	8.410+003	4.621+004	0.000	5.451+004	0.000
7	1	0.000	0.000	-9.644+000	0.000	-5.628-001	0.000	-8.090+000	0.000	0.000	4.440+000
7	11	8.572+000	0.000	8.447+000	0.000	0.000	0.000	0.000	0.000	9.502+001	0.000
7	21	4.345+000	8.436+000	-1.501-009	0.000	1.151+003	0.000	2.737-024	2.575+004	1.501-009	1.218-001
8	1	0.000	1.269+000	0.000	0.000	0.000	0.000	0.000	-1.269+000	0.000	0.000
8	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-1.250+001	0.000	0.000
8	21	0.000	0.000	2.274-013	0.000	0.000	3.358+003	3.731+004	0.000	-2.274-013	0.000
9	1	2.471-001	8.765+000	0.000	3.984+000	0.000	-1.741+000	0.000	0.000	-3.984+000	0.000
9	11	0.000	-7.866-008	0.000	2.435+000	0.000	0.000	0.000	-7.866-008	0.000	-3.925+001
9	21	0.000	0.000	1.217+000	6.185+002	0.000	2.204+003	1.259+004	0.000	1.374+004	0.000
10	1	0.000	0.000	4.726-002	0.000	-3.138-001	0.000	2.588-002	0.000	0.000	-2.602-001
10	11	9.564-002	0.000	9.425-002	0.000	0.000	0.000	0.000	0.000	-4.656-001	0.000
10	21	2.691+000	9.540-002	-1.674-011	0.000	9.333+000	0.000	2.090-026	1.966+002	1.674-011	4.070-002
11	1	0.000	0.000	1.042-001	0.000	2.121-001	0.000	5.704-002	0.000	0.000	1.092-001
11	11	-1.833-001	0.000	2.077-001	0.000	0.000	0.000	0.000	0.000	-1.026+000	0.000
11	21	-1.835+000	2.123-001	-3.690-011	0.000	2.831+001	0.000	6.732-026	6.333+002	3.690-011	-2.591-002
12	1	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN) CURRENT TIME = 084932
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT THE CPU TIMER = 38 SEC

OUTPUT MATRIX -A*- (32 X 32) CONTINUED

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
13	1	0.000	0.000	0.000	0.000	-6.667-002	0.000	0.000	0.000	0.000	0.000
13	21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.667-002
14	1	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	1	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	1	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000
17	1	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000
18	1	0.000	-1.000+000	0.000	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000
19	1	0.000	0.000	-1.000+000	0.000	0.000	0.000	-7.500-001	0.000	0.000	5.000-001
19	11	8.660-001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	21	0.000	0.000	0.000	0.000	-9.250-001	0.000	0.000	0.000	0.000	0.000
20	1	0.000	-2.200+000	0.000	-1.000+000	0.000	3.750-001	0.000	0.000	1.000+000	0.000
21	1	0.000	0.000	0.000	0.000	-1.147+000	0.000	0.000	0.000	0.000	-8.660-001
21	11	5.000-001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	21	0.000	0.000	0.000	0.000	1.602+000	0.000	0.000	0.000	0.000	1.467-001
22	1	0.000	0.000	0.000	0.000	0.000	-4.039-028	-1.000+000	0.000	0.000	8.674-019
22	11	-4.337-019	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	21	0.000	0.000	0.000	3.503-046	1.000+000	9.571-046	0.000	0.000	0.000	0.000
23	1	0.000	0.000	0.000	0.000	0.000	-2.000+000	0.000	0.000	0.000	0.000
23	21	0.000	0.000	0.000	1.000+000	0.000	1.732+000	0.000	0.000	0.000	0.000
24	1	-3.939-002	4.281-001	0.000	1.946-001	0.000	-3.358-002	0.000	0.000	-1.946-001	0.000
24	11	0.000	1.602-008	0.000	-3.881-001	0.000	0.000	0.000	1.602-008	0.000	-1.917+000
24	21	0.000	0.000	-1.941-001	-1.357+002	0.000	-4.156+002	-2.006+003	0.000	-3.014+003	0.000
25	1	0.000	0.000	-9.194-002	0.000	6.106-001	0.000	-5.035-002	0.000	0.000	5.062-001
25	11	-1.861-001	0.000	-1.834-001	0.000	0.000	0.000	0.000	0.000	9.059-001	0.000
25	21	-5.236+000	-2.014-001	3.258-011	0.000	-5.526+001	0.000	-1.282-025	-1.207+003	-3.258-011	-7.918-002
26	1	0.000	0.000	0.000	0.000	0.000	-1.388-017	0.000	0.000	0.000	0.000
26	21	0.000	0.000	-7.981-009	-5.748+001	0.000	-2.323+002	-1.475+003	0.000	-1.277+003	0.000
27	1	0.000	0.000	0.000	0.000	0.000	3.903-016	0.000	0.000	0.000	0.000
27	21	0.000	0.000	0.000	0.000	0.000	2.000+000	0.000	0.000	0.000	0.000

ORIGINAL PAGE IS OF POOR QUALITY

VI-52

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084933
THE CPU TIMER = 38 SEC

OUTPUT MATRIX -A*- (32 X 32) CONTINUED

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
28	1	0.000	0.000	0.000	0.000	0.000	3.553-018	1.694-012	0.000	0.000	8.674-019
28	11	-4.337-019	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	21	0.000	0.000	0.000	-2.019-028	1.000+000	-5.622-028	0.000	0.000	0.000	0.000
29	1	0.000	0.000	0.000	0.000	0.000	3.931-016	0.000	0.000	0.000	0.000
29	21	0.000	0.000	0.000	1.000+000	0.000	1.732+000	0.000	0.000	0.000	0.000
30	1	0.000	0.000	0.000	0.000	-1.088-002	0.000	1.279-004	0.000	0.000	-8.225-003
30	11	4.749-003	0.000	-1.260-003	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	21	9.358-002	-1.260-003	2.238-013	0.000	1.522-002	0.000	-2.545-031	1.260-003	-2.238-013	1.384-003
30	31	0.000	4.404-005								
31	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.674-019
31	11	-4.337-019	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
31	21	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000
32	31	1.000+000	0.000								

END OF WRITE.

RUN NO. IOG 2 DATE 091275 PAGE NO. , 17

RUN BY

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084934
THE CPU TIMER = 39 SEC

	RT A		RTA*	
NO	REAL PART	IMAGINARY PART	REAL PART	IMAGINARY PART
1	-.32146+003	.00000	-.32146+003	.00000
2	-.27040+002	-.21868+002	-.27040+002	-.21868+002
3	-.27040+002	.21868+002	-.27040+002	.21868+002
4	-.23898+002	.00000	-.23898+002	.00000
5	-.10860+002	-.19266+002	-.10860+002	-.19266+002
6	-.10860+002	.19266+002	-.10860+002	.19266+002
7	-.46640+001	-.83359+001	-.46640+001	-.83359+001
8	-.46640+001	.83359+001	-.46640+001	.83359+001
9	-.46587+001	-.83154+001	-.46587+001	-.83154+001
10	-.46587+001	.83154+001	-.46587+001	.83154+001
11	-.63430+000	-.34782+001	-.63430+000	-.34782+001
12	-.63430+000	.34782+001	-.63430+000	.34782+001
13	-.20270+000	-.19914+001	-.20270+000	-.19914+001
14	-.20270+000	.19914+001	-.20270+000	.19914+001
15	-.10212-001	-.44868+000	-.10212-001	-.44868+000
16	-.10212-001	.44868+000	-.10212-001	.44868+000
17	-.10186-001	-.43904+000	-.10186-001	-.43904+000
18	-.10186-001	.43904+000	-.10186-001	.43904+000
19	-.17628-002	.00000	-.17628-002	.00000
20	-.13112-004	.00000	-.13112-004	.00000
21	.00000	.00000	.00000	.00000
22	.00000	.00000	.00000	.00000
23	.00000	.00000	.00000	.00000
24	.00000	.00000	.00000	.00000
25	.00000	.00000	.00000	.00000
26	.00000	.00000	.00000	.00000
27	.00000	.00000	.00000	.00000
28	.00000	.00000	.00000	.00000
29	.00000	.00000	.00000	.00000
30	.00000	.00000	.00000	.00000
31	.00000	.00000	.00000	.00000
32	.17759-002	.00000	.17759-002	.00000

VI-54

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084942
THE CPU TIMER = 44 SEC

OUTPUT MATRIX -AR- (30 X 30)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	-6.337-005	0.000	0.000	0.000	0.000	6.337-005	0.000	0.000	0.000	0.000
1	11	0.000	0.000	0.000	-6.244-004	0.000	0.000	0.000	0.000	0.000	0.000
1	21	0.000	0.000	-3.122-004	0.000	0.000	0.000	5.416-022	0.000	3.122-004	0.000
2	1	0.000	-6.504-004	0.000	-2.919-004	0.000	1.094-004	0.000	8.292-006	2.919-004	0.000
2	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.170-005	0.000	2.876-003
3	1	0.000	0.000	-1.400-002	0.000	0.000	0.000	-1.050-002	0.000	0.000	7.000-003
3	11	1.212-002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.379-001	0.000
3	21	0.000	0.000	0.000	0.000	-1.295-002	0.000	0.000	0.000	0.000	0.000
4	1	0.000	-3.080-002	0.000	-1.400-002	0.000	5.250-003	0.000	0.000	1.400-002	0.000
4	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.379-001
5	1	0.000	0.000	0.000	0.000	-1.605-002	0.000	0.000	0.000	0.000	-1.212-002
5	11	7.000-003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	21	1.379-001	0.000	0.000	0.000	2.243-002	0.000	0.000	0.000	0.000	2.053-003
6	1	9.072-001	2.067+001	0.000	9.397+000	0.000	-4.431+000	0.000	0.000	-9.397+000	0.000
6	11	0.000	-2.888-007	0.000	8.939+000	0.000	0.000	0.000	-2.888-007	0.000	-9.259+001
6	21	0.000	0.000	4.470+000	2.454+003	0.000	8.410+003	4.621+004	0.000	5.451+004	0.000
7	1	0.000	0.000	-9.644+000	0.000	-5.628-001	0.000	-8.090+000	0.000	0.000	4.440+000
7	11	8.572+000	0.000	8.447+000	0.000	0.000	0.000	0.000	0.000	9.502+001	0.000
7	21	4.345+000	8.436+000	-1.501-009	0.000	1.151+003	0.000	2.737-024	2.575+004	1.501-009	1.218-001
8	1	0.000	1.269+000	0.000	0.000	0.000	0.000	0.000	-1.269+000	0.000	0.000
8	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-1.250+001	0.000	0.000
8	21	0.000	0.000	2.274-013	0.000	0.000	3.358+003	3.731+004	0.000	-2.274-013	0.000
9	1	2.471-001	8.765+000	0.000	3.984+000	0.000	-1.741+000	0.000	0.000	-3.984+000	0.000
9	11	0.000	-7.866-008	0.000	2.435+000	0.000	0.000	0.000	-7.866-008	0.000	-3.925+001
9	21	0.000	0.000	1.217+000	6.185+002	0.000	2.204+003	1.259+004	0.000	1.374+004	0.000
10	1	0.000	0.000	4.726-002	0.000	-3.138-001	0.000	2.588-002	0.000	0.000	-2.602-001
10	11	9.564-002	0.000	9.425-002	0.000	0.000	0.000	0.000	0.000	-4.656-001	0.000
10	21	2.691+000	9.540-002	-1.674-011	0.000	9.333+000	0.000	2.090-026	1.966+002	1.674-011	4.070-002
11	1	0.000	0.000	1.042-001	0.000	2.121-001	0.000	5.704-002	0.000	0.000	1.092-001
11	11	-1.833-001	0.000	2.077-001	0.000	0.000	0.000	0.000	0.000	-1.026+000	0.000
11	21	-1.835+000	2.123-001	-3.690-011	0.000	2.831+001	0.000	6.732-026	6.333+002	3.690-011	-2.591-002
12	1	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084942
THE CPU TIMER = 44 SEC

OUTPUT MATRIX -AR- (30 X 30) CONTINUED

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
13	1	0.000	0.000	0.000	0.000	-6.667-002	0.000	0.000	0.000	0.000	0.000
13	21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.667-002
14	1	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	1	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	1	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000
17	1	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000
18	1	0.000	-1.000+000	0.000	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000
19	1	0.000	0.000	-1.000+000	0.000	0.000	0.000	-7.500-001	0.000	0.000	5.000-001
19	11	8.660-001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	21	0.000	0.000	0.000	0.000	-9.250-001	0.000	0.000	0.000	0.000	0.000
20	1	0.000	-2.200+000	0.000	-1.000+000	0.000	3.750-001	0.000	0.000	1.000+000	0.000
21	1	0.000	0.000	0.000	0.000	-1.147+000	0.000	0.000	0.000	0.000	-8.660-001
21	11	5.000-001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	21	0.000	0.000	0.000	0.000	1.602+000	0.000	0.000	0.000	0.000	1.467-001
22	1	0.000	0.000	0.000	0.000	0.000	-4.039-028	-1.000+000	0.000	0.000	8.674-019
22	11	-4.337-019	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	21	0.000	0.000	0.000	3.503-046	1.000+000	9.571-046	0.000	0.000	0.000	0.000
23	1	0.000	0.000	0.000	0.000	0.000	-2.000+000	0.000	0.000	0.000	0.000
23	21	0.000	0.000	0.000	1.000+000	0.000	1.732+000	0.000	0.000	0.000	0.000
24	1	-3.939-002	4.281-001	0.000	1.946-001	0.000	-3.358-002	0.000	0.000	-1.946-001	0.000
24	11	0.000	1.602-008	0.000	-3.881-001	0.000	0.000	0.000	1.602-008	0.000	-1.917+000
24	21	0.000	0.000	-1.941-001	-1.357+002	0.000	-4.156+002	-2.006+003	0.000	-3.014+003	0.000
25	1	0.000	0.000	-9.194-002	0.000	6.106-001	0.000	-5.035-002	0.000	0.000	5.062-001
25	11	-1.861-001	0.000	-1.834-001	0.000	0.000	0.000	0.000	0.000	9.059-001	0.000
25	21	-5.236+000	-2.014-001	3.258-011	0.000	-5.526+001	0.000	-1.282-025	-1.207+003	-3.258-011	-7.918-002
26	1	0.000	0.000	0.000	0.000	0.000	-1.388-017	0.000	0.000	0.000	0.000
26	21	0.000	0.000	-7.981-009	-5.748+001	0.000	-2.323+002	-1.475+003	0.000	-1.277+003	0.000
27	1	0.000	0.000	0.000	0.000	0.000	3.903-016	0.000	0.000	0.000	0.000
27	21	0.000	0.000	0.000	0.000	0.000	2.000+000	0.000	0.000	0.000	0.000

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084942
THE CPU TIMER = 44 SEC

OUTPUT MATRIX -AR- (30 X 30) CONTINUED

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
28	1	0.000	0.000	0.000	0.000	0.000	3.553-010	1.694-012	0.000	0.000	8.674-019
28	11	-4.337-019	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	21	0.000	0.000	0.000	-2.019-028	1.000+000	-5.622-028	0.000	0.000	0.000	0.000
29	1	0.000	0.000	0.000	0.000	0.000	3.931-016	0.000	0.000	0.000	0.000
29	21	0.000	0.000	0.000	1.000+000	0.000	1.732+000	0.000	0.000	0.000	0.000
30	1	0.000	0.000	0.000	0.000	-1.088-002	0.000	1.279-004	0.000	0.000	-8.225-003
30	11	4.749-003	0.000	-1.260-003	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	21	9.358-002	-1.260-003	2.238-013	0.000	1.522-002	0.000	-2.545-031	1.260-003	-2.238-013	1.384-003

END OF WRITE.

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084942
THE CPU TIMER = 44 SEC

OUTPUT MATRIX BCOL (1 X 30)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	0.000	0.000	0.000	0.000	1.379-005	0.000	0.000	0.000	0.000	0.000
1	21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.404-005

END OF WRITE.

VI-58

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084945
THE CPU TIMER = 46 SEC

	R AR		RART	
NO	REAL PART	IMAGINARY PART	REAL PART	IMAGINARY PART
1	-.32146+003	.00000	-.32146+003	.00000
2	-.27040+002	-.21868+002	-.27040+002	-.21868+002
3	-.27040+002	.21868+002	-.27040+002	.21868+002
4	-.23898+002	.00000	-.23898+002	.00000
5	-.10860+002	-.19266+002	-.10860+002	.19266+002
6	-.10860+002	.19266+002	-.10860+002	-.19266+002
7	-.46640+001	-.83359+001	-.46640+001	-.83359+001
8	-.46640+001	.83359+001	-.46640+001	.83359+001
9	-.46587+001	-.83154+001	-.46587+001	-.83154+001
10	-.46587+001	.83154+001	-.46587+001	.83154+001
11	-.63430+000	-.34782+001	-.63430+000	-.34782+001
12	-.63430+000	.34782+001	-.63430+000	.34782+001
13	-.20270+000	-.19914+001	-.20270+000	-.19914+001
14	-.20270+000	.19914+001	-.20270+000	.19914+001
15	-.10212-001	-.44868+000	-.10212-001	-.44868+000
16	-.10212-001	.44868+000	-.10212-001	.44868+000
17	-.10186-001	-.43904+000	-.10186-001	-.43904+000
18	-.10186-001	.43904+000	-.10186-001	.43904+000
19	-.17694-002	.00000	-.17694-002	.00000
20	.00000	.00000	.00000	.00000
21	.00000	.00000	.00000	.00000
22	.00000	.00000	.00000	.00000
23	.00000	.00000	.00000	.00000
24	.00000	.00000	.00000	.00000
25	.00000	.00000	.00000	.00000
26	.00000	.00000	.00000	.00000
27	.00000	.00000	.00000	.00000
28	.00000	.00000	.00000	.00000
29	.00000	.00000	.00000	.00000
30	.17694-002	.00000	.17694-002	.00000

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084946
THE CPU TIMER = 47 SEC

OUTPUT MATRIX DRATIO (1 X 30)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	1.732+000	1.731+000	1.718+000	1.718+000	1.716+000	5.451+004	2.575+004	3.731+004	-1.605+001	2.683+000
1	11	-4.268+000	1.732+000	1.732+000	1.732+000	1.732+000	1.732+000	1.732+000	1.732+000	1.449+000	1.020+000
1	21	-2.136+000	1.732+000	-2.000+000	1.973+000	1.729+000	1.846+000	-2.000-001	-1.497-003	1.271-001	-6.907-006

END OF WRITE.

CURRENT TIME = 084948
THE CPU TIMER = 48 SEC

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

	NUM		DEN	
NO	REAL PART	IMAGINARY PART	REAL PART	IMAGINARY PART
1	-.98533+001	.00000	-.32146+003	.00000
2	-.23898+002	.00000	-.27040+002	-.21868+002
3	-.46640+001	.83359+001	-.27040+002	.21868+002
4	-.46640+001	-.83359+001	-.23898+002	.00000
5	-.41031+001	.79997+001	-.10860+002	-.19266+002
6	-.41031+001	-.79997+001	-.10860+002	.19266+002
7	-.10860+002	.19266+002	-.46640+001	-.83359+001
8	-.10860+002	-.19266+002	-.46640+001	.83359+001
9	-.32146+003	.00000	-.46587+001	-.83154+001
10	-.63430+000	.34782+001	-.46587+001	.83154+001
11	-.63430+000	-.34782+001	-.63430+000	-.34782+001
12	-.19118-001	.61702+000	-.63430+000	.34782+001
13	-.19118-001	-.61702+000	-.20270+000	-.19914+001
14	-.10212-001	.44868+000	-.20270+000	.19914+001
15	-.10212-001	-.44868+000	-.10212-001	-.44868+000
16	.00000	.48232-001	-.10212-001	.44868+000
17	.00000	-.48232-001	-.10186-001	-.43904+000
18	.00000	.00000	-.10186-001	.43904+000
19	.00000	.00000	-.17694-002	.00000
20	.00000	.00000	.00000	.00000
21	.00000	.00000	.00000	.00000
22	.00000	.00000	.00000	.00000
23	.00000	.00000	.00000	.00000
24	.00000	.00000	.00000	.00000
25	.00000	.00000	.00000	.00000
26	.00000	.00000	.00000	.00000
27	.00000	.00000	.00000	.00000
28	.00000	.00000	.00000	.00000
29			.00000	.00000
30			.17694-002	.00000

RUN NO. IOG 2 DATE 091275 PAGE NO. 32

RUN BY

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084948
THE CPU TIMER = 49 SEC

OUTPUT MATRIX RRED (1 X 107)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	1.000+000	7.000+000	1.000+000	2.000+000	8.000+000	0.000	-1.311-005	1.015-001	4.883-001	9.552+000
1	11	4.564-001	8.991+000	4.911-001	2.212+001	1.794-001	3.536+000	3.097-002	6.173-001	2.275-002	4.488-001
1	21	0.000	4.823-002	5.652+002	-5.652+002	7.775-001	3.478+001	4.911-001	2.212+001	4.883-001	9.552+000
1	31	4.888-001	9.531+000	1.794-001	3.536+000	1.013-001	2.002+000	2.275-002	4.488-001	2.320-002	4.392-001

END OF WRITE.

ORIGINAL PAGE IS
OF POOR QUALITY

RUN NO. IOG 2 DATE 091275 PAGE NO. 33

RUN BY

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)

SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084948

THE CPU TIMER = 49 SEC

VI-62

PITCH RATE ERROR / CREW MOTION FORCE

FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG
.100000-001	.159155-002	-.192930-011	-.381018-008	.381018-008	-168.381	4.7119	269.9710
.110000-001	.175070-002	-.192250-011	-.344950-008	.344950-008	-169.245	4.7118	269.9680
.125000-001	.198944-002	-.190415-011	-.300443-008	.300443-008	-170.445	4.7118	269.9637
.140000-001	.222817-002	-.187809-011	-.264422-008	.264422-008	-171.554	4.7117	269.9593
.160000-001	.254648-002	-.183352-011	-.225722-008	.225723-008	-172.929	4.7116	269.9534
.180000-001	.286479-002	-.177930-011	-.194583-008	.194583-008	-174.218	4.7115	269.9476
.200000-001	.318310-002	-.171633-011	-.168820-008	.168820-008	-175.451	4.7114	269.9417
.220000-001	.350141-002	-.164514-011	-.147014-008	.147014-008	-176.653	4.7113	269.9359
.250000-001	.397887-002	-.152355-011	-.119692-008	.119692-008	-178.439	4.7111	269.9270
.280000-001	.445634-002	-.138466-011	-.970217-009	.970218-009	-180.263	4.7110	269.9182
.289392-001	.460582-002	-.133766-011	-.906545-009	.906546-009	-180.852	4.7109	269.9154
.337624-001	.537346-002	-.107000-011	-.620345-009	.620346-009	-184.147	4.7107	269.9011
.361740-001	.575728-002	-.919639-012	-.497095-009	.497095-009	-186.071	4.7105	269.8940
.385856-001	.614110-002	-.758199-012	-.383780-009	.383781-009	-188.318	4.7104	269.8868
.405149-001	.644815-002	-.621024-012	-.299089-009	.299090-009	-190.484	4.7103	269.8810
.424442-001	.675521-002	-.476670-012	-.218912-009	.218913-009	-193.195	4.7102	269.8752
.434089-001	.690873-002	-.401784-012	-.180327-009	.180327-009	-194.879	4.7102	269.8723
.443735-001	.706226-002	-.325085-012	-.142655-009	.142656-009	-196.914	4.7101	269.8694
.453381-001	.721579-002	-.246564-012	-.105839-009	.105839-009	-199.507	4.7101	269.8665
.463028-001	.736932-002	-.166215-012	-.698236-010	.698238-010	-203.120	4.7100	269.8636
.465439-001	.740770-002	-.145841-012	-.609389-010	.609391-010	-204.302	4.7100	269.8628
.467851-001	.744608-002	-.125352-012	-.521005-010	.521006-010	-205.663	4.7100	269.8621
.470263-001	.748446-002	-.104749-012	-.433075-010	.433076-010	-207.269	4.7100	269.8614
.472674-001	.752284-002	-.840296-013	-.345592-010	.345593-010	-209.229	4.7100	269.8607
.474603-001	.755355-002	-.673715-013	-.275924-010	.275924-010	-211.184	4.7099	269.8601
.476533-001	.758425-002	-.506395-013	-.206534-010	.206534-010	-213.700	4.7099	269.8595
.477497-001	.759961-002	-.422458-013	-.171942-010	.171942-010	-215.292	4.7099	269.8592
.478462-001	.761496-002	-.338337-013	-.137418-010	.137419-010	-217.239	4.7099	269.8589
.479427-001	.763031-002	-.254030-013	-.102963-010	.102963-010	-219.746	4.7099	269.8586
.480391-001	.764566-002	-.169538-013	-.685751-011	.685753-011	-223.277	4.7099	269.8583
.481356-001	.766102-002	-.848618-014	-.342542-011	.342543-011	-229.306	4.7099	269.8580
.481742-001	.766716-002	-.509393-014	-.205445-011	.205446-011	-233.746	4.7099	269.8579
.482079-001	.767253-002	-.212328-014	-.855732-012	.855735-012	-241.353	4.7099	269.8578
.482200-001	.767445-002	-.106179-014	-.427814-012	.427816-012	-247.375	4.7099	269.8578
.482272-001	.767560-002	-.424749-015	-.171113-012	.171114-012	-255.334	4.7099	269.8577
.482282-001	.767576-002	-.339803-015	-.136889-012	.136890-012	-257.273	4.7099	269.8577
.482292-001	.767591-002	-.254855-015	-.102666-012	.102666-012	-259.771	4.7099	269.8577
.482301-001	.767606-002	-.169905-015	-.684434-013	.684436-013	-263.293	4.7099	269.8577
.482311-001	.767622-002	-.849535-016	-.342213-013	.342215-013	-269.314	4.7099	269.8577
.482316-001	.767629-002	-.424770-016	-.171106-013	.171106-013	-275.335	4.7099	269.8577

RUN BY

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084949
THE CPU TIMER = 49 SEC

PITCH RATE ERROR / CREW MOTION FORCE

	FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG	
********	.482321-001	.767637-002	.000000	.000000	.000000	-173.718	.0000	.0000	********
	.482325-001	.767645-002	.424779-016	.171106-013	.171106-013	-275.335	1.5683	89.8578	
	.482330-001	.767652-002	.849571-016	.342214-013	.342215-013	-269.314	1.5683	89.8578	
	.482340-001	.767668-002	.169919-015	.684434-013	.684437-013	-263.293	1.5683	89.8578	
	.482350-001	.767683-002	.254887-015	.102666-012	.102667-012	-259.771	1.5683	89.8578	
	.482359-001	.767698-002	.339860-015	.136890-012	.136890-012	-257.273	1.5683	89.8578	
	.482369-001	.767714-002	.424838-015	.171114-012	.171114-012	-255.334	1.5683	89.8578	
	.482441-001	.767829-002	.106234-014	.427818-012	.427819-012	-247.375	1.5683	89.8578	
	.482562-001	.768021-002	.212550-014	.855746-012	.855749-012	-241.353	1.5683	89.8577	
	.482900-001	.768559-002	.510673-014	.205453-011	.205454-011	-233.746	1.5683	89.8576	
	.483287-001	.769175-002	.852177-014	.342564-011	.342565-011	-229.305	1.5683	89.8575	
	.484258-001	.770720-002	.170965-013	.685839-011	.685841-011	-223.276	1.5683	89.8572	
	.485232-001	.772271-002	.257246-013	.102983-010	.102983-010	-219.745	1.5683	89.8569	
	.486210-001	.773828-002	.344065-013	.137454-010	.137454-010	-217.237	1.5683	89.8566	
	.487192-001	.775391-002	.431427-013	.171997-010	.171998-010	-215.290	1.5683	89.8563	
	.488179-001	.776961-002	.519336-013	.206613-010	.206614-010	-213.697	1.5683	89.8560	
	.490163-001	.780119-002	.696816-013	.276066-010	.276067-010	-211.180	1.5683	89.8554	
	.492164-001	.783303-002	.876541-013	.345815-010	.345816-010	-209.223	1.5683	89.8548	
	.494688-001	.787320-002	.110441-012	.433425-010	.433426-010	-207.262	1.5682	89.8540	
	.497238-001	.791378-002	.133593-012	.521512-010	.521514-010	-205.655	1.5682	89.8533	
	.499814-001	.795479-002	.157117-012	.610084-010	.610086-010	-204.292	1.5682	89.8525	
	.502417-001	.799622-002	.181021-012	.699148-010	.699150-010	-203.109	1.5682	89.8517	
	.513107-001	.816635-002	.280611-012	.106049-009	.106049-009	-199.490	1.5682	89.8484	
	.524261-001	.834388-002	.386994-012	.143038-009	.143038-009	-196.891	1.5681	89.8450	
	.535912-001	.852930-002	.500805-012	.180939-009	.180940-009	-194.849	1.5680	89.8414	
	.548092-001	.872315-002	.622757-012	.219818-009	.219819-009	-193.159	1.5680	89.8377	
	.574191-001	.913854-002	.894393-012	.300795-009	.300796-009	-190.435	1.5678	89.8297	
	.602901-001	.959546-002	.120964-011	.386621-009	.386623-009	-188.254	1.5677	89.8208	
	.643094-001	.102352-001	.168048-011	.501952-009	.501955-009	-185.987	1.5674	89.8082	
	.689029-001	.109662-001	.226176-011	.628102-009	.628107-009	-184.039	1.5672	89.7937	
	.700000-001	.111408-001	.240755-011	.657474-009	.657478-009	-183.642	1.5671	89.7902	
	.780000-001	.124141-001	.355448-011	.864576-009	.864584-009	-181.264	1.5667	89.7645	
	.890000-001	.141648-001	.538500-011	.113441-008	.113443-008	-178.904	1.5660	89.7281	
	.100000+000	.159155-001	.753472-011	.139358-008	.139360-008	-177.117	1.5654	89.6703	
	.110000+000	.175070-001	.979469-011	.162402-008	.162405-008	-175.788	1.5648	89.6575	
	.125000+000	.198944-001	.138020-010	.196612-008	.196617-008	-174.128	1.5638	89.5978	
	.140000+000	.222817-001	.186708-010	.230946-008	.230953-008	-172.730	1.5627	89.5368	
	.160000+000	.254648-001	.268129-010	.277772-008	.277785-008	-171.126	1.5611	89.4470	
	.180000+000	.286479-001	.373767-010	.326756-008	.326778-008	-169.715	1.5594	89.3445	
	.200000+000	.318310-001	.512583-010	.378988-008	.379023-008	-168.427	1.5573	89.2252	

ORIGINAL PAGE IS
OF POOR QUALITY

VI-64

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084949
THE CPU TIMER = 50 SEC

PITCH RATE ERROR / CREW MOTION FORCE

FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG
.220000+000	.350141-001	.697465-010	.435756-008	.435811-008	-167.214	1.5548	89.0830
.250000+000	.397887-001	.111002-009	.533229-008	.533345-008	-165.460	1.5500	88.8075
.263354+000	.419141-001	.137425-009	.583260-008	.583422-008	-164.680	1.5472	88.6503
.307246+000	.488998-001	.296684-009	.796313-008	.796866-008	-161.972	1.5336	87.8663
.329193+000	.523926-001	.465994-009	.950910-008	.952051-008	-160.427	1.5218	87.1945
.351139+000	.558855-001	.790298-009	.116870-007	.117137-007	-158.626	1.5033	86.1315
.368696+000	.586798-001	.131292-008	.142606-007	.143209-007	-156.881	1.4790	84.7398
.386253+000	.614740-001	.246153-008	.182968-007	.184616-007	-154.675	1.4371	82.3378
.395031+000	.628712-001	.361281-008	.213312-007	.216349-007	-153.297	1.4030	80.3872
.403810+000	.642683-001	.568258-008	.255639-007	.261879-007	-151.638	1.3521	77.4676
.412588+000	.656654-001	.986709-008	.317273-007	.332262-007	-149.570	1.2693	72.7245
.421367+000	.670626-001	.197760-007	.406177-007	.451762-007	-146.902	1.1177	64.0395
.423561+000	.674119-001	.241936-007	.431217-007	.494451-007	-146.118	1.0595	60.7052
.425756+000	.677611-001	.299258-007	.454371-007	.544067-007	-145.287	.9884	56.6303
.427950+000	.681104-001	.373399-007	.471145-007	.601169-007	-144.420	.9006	51.6019
.430145+000	.684597-001	.467408-007	.473326-007	.665212-007	-143.541	.7917	45.3605
.431901+000	.687391-001	.556725-007	.455801-007	.719512-007	-142.859	.6861	39.3079
.433656+000	.690186-001	.653988-007	.411691-007	.772781-007	-142.239	.5618	32.1908
.434534+000	.691583-001	.702483-007	.377004-007	.797254-007	-141.968	.4926	28.2213
.435412+000	.692980-001	.748300-007	.333004-007	.819051-007	-141.734	.4187	23.9898
.436290+000	.694377-001	.789021-007	.279732-007	.837141-007	-141.544	.3407	19.5210
.437168+000	.695774-001	.822094-007	.218035-007	.850516-007	-141.406	.2593	14.8540
.438046+000	.697171-001	.845169-007	.149661-007	.858317-007	-141.327	.1753	10.0417
.438397+000	.697730-001	.851178-007	.120994-007	.859734-007	-141.313	.1412	8.0903
.438704+000	.698219-001	.854825-007	.955171-008	.860145-007	-141.309	.1113	6.3757
.438814+000	.698394-001	.855756-007	.863567-008	.860102-007	-141.309	.1006	5.7624
.438880+000	.698499-001	.856220-007	.808493-008	.860028-007	-141.310	.0941	5.3942
.438888+000	.698513-001	.856276-007	.801144-008	.860016-007	-141.310	.0933	5.3451
.438897+000	.698527-001	.856331-007	.793795-008	.860003-007	-141.310	.0924	5.2960
.438906+000	.698541-001	.856385-007	.786444-008	.859989-007	-141.310	.0916	5.2469
.438915+000	.698555-001	.856438-007	.779092-008	.859974-007	-141.310	.0907	5.1978
.438919+000	.698562-001	.856464-007	.775415-008	.859967-007	-141.310	.0903	5.1733
******** .438924+000	.698569-001	.856490-007	.771739-008	.859959-007	-141.310	.0899	5.1487 ********
.438928+000	.698576-001	.856515-007	.768062-008	.859952-007	-141.311	.0894	5.1242
.438932+000	.698583-001	.856540-007	.764385-008	.859944-007	-141.311	.0890	5.0996
.438941+000	.698596-001	.856589-007	.757029-008	.859927-007	-141.311	.0881	5.0505
.438950+000	.698610-001	.856636-007	.749673-008	.859910-007	-141.311	.0873	5.0014
.438959+000	.698624-001	.856682-007	.742315-008	.859893-007	-141.311	.0864	4.9523
.438967+000	.698638-001	.856728-007	.734956-008	.859874-007	-141.311	.0856	4.9032
.439033+000	.698743-001	.857025-007	.679728-008	.859717-007	-141.313	.0791	4.5348
.439143+000	.698918-001	.857362-007	.587576-008	.859373-007	-141.316	.0684	3.9205

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN) CURRENT TIME = 084949
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT THE CPU TIMER = 50 SEC

PITCH RATE ERROR / CREW MOTION FORCE

	FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG	
	.439451+000	.699408-001	.857247-007	.329344-008	.857880-007	-141.331	.0384	2.2002	
	.439803+000	.699968-001	.855209-007	.352888-009	.855216-007	-141.358	.0041	.2364	
	.440686+000	.701374-001	.841472-007	-.681784-008	.844229-007	-141.471	6.2023	355.3679	
	.441573+000	.702785-001	.816443-007	-.134985-007	.827526-007	-141.644	6.1193	350.6120	
	.442463+000	.704202-001	.782106-007	-.194583-007	.805948-007	-141.874	6.0393	346.0288	
	.443357+000	.705625-001	.740898-007	-.245532-007	.780523-007	-142.152	5.9632	341.6649	
	.444077+000	.706770-001	.704570-007	-.279748-007	.758075-007	-142.406	5.9052	338.3446	
	.444974+000	.708198-001	.657352-007	-.314074-007	.728529-007	-142.751	5.8375	334.4622	
	.445871+000	.709626-001	.609798-007	-.339857-007	.698109-007	-143.122	5.7747	330.8679	
	.446768+000	.711054-001	.563383-007	-.358127-007	.667574-007	-143.510	5.7169	327.5570	
	.447665+000	.712482-001	.519116-007	-.370039-007	.637503-007	-143.910	5.6639	324.5178	
	.448024+000	.713053-001	.502159-007	-.373281-007	.625701-007	-144.073	5.6439	323.3746	
	.448338+000	.713553-001	.487706-007	-.375489-007	.615507-007	-144.215	5.6271	322.4070	
	.448450+000	.713731-001	.482634-007	-.376144-007	.611899-007	-144.266	5.6212	322.0686	
	.448518+000	.713838-001	.479613-007	-.376505-007	.609742-007	-144.297	5.6176	321.8674	
	.448527+000	.713852-001	.479212-007	-.376552-007	.609455-007	-144.301	5.6172	321.8407	
	.448536+000	.713867-001	.478811-007	-.376597-007	.609168-007	-144.305	5.6167	321.8140	
	.448545+000	.713881-001	.478410-007	-.376643-007	.608881-007	-144.309	5.6162	321.7873	
	.448554+000	.713895-001	.478010-007	-.376688-007	.608594-007	-144.313	5.6158	321.7607	
	.448558+000	.713902-001	.477810-007	-.376710-007	.608451-007	-144.315	5.6155	321.7473	
********	.448563+000	.713910-001	.477610-007	-.376733-007	.608308-007	-144.318	5.6153	321.7340	********
********	.448563+000	.713910-001	.477610-007	-.376733-007	.608308-007	-144.318	5.6153	321.7340	********
	.448567+000	.713917-001	.477410-007	-.376755-007	.608165-007	-144.320	5.6151	321.7207	
	.448572+000	.713924-001	.477210-007	-.376777-007	.608021-007	-144.322	5.6149	321.7074	
	.448581+000	.713938-001	.476810-007	-.376821-007	.607735-007	-144.326	5.6144	321.6808	
	.448589+000	.713952-001	.476411-007	-.376864-007	.607449-007	-144.330	5.6139	321.6543	
	.448598+000	.713967-001	.476012-007	-.376907-007	.607162-007	-144.334	5.6135	321.6277	
	.448607+000	.713981-001	.475613-007	-.376950-007	.606876-007	-144.338	5.6130	321.6012	
	.448675+000	.714088-001	.472637-007	-.377256-007	.604734-007	-144.369	5.6095	321.4030	
	.448787+000	.714267-001	.467701-007	-.377717-007	.601177-007	-144.420	5.6038	321.0755	
	.449101+000	.714767-001	.454142-007	-.378687-007	.591311-007	-144.564	5.5881	320.1769	
	.449461+000	.715340-001	.439099-007	-.379256-007	.580210-007	-144.728	5.5708	319.1824	
	.450364+000	.716777-001	.403626-007	-.378499-007	.553332-007	-145.140	5.5299	316.8401	
	.451270+000	.718219-001	.371169-007	-.375205-007	.527774-007	-145.551	5.4924	314.6901	
	.452180+000	.719667-001	.341609-007	-.369994-007	.503579-007	-145.959	5.4579	312.7157	
	.453094+000	.721121-001	.314771-007	-.363367-007	.480745-007	-146.362	5.4262	310.9011	
	.454011+000	.722580-001	.290449-007	-.355728-007	.459242-007	-146.759	5.3971	309.2314	
	.455856+000	.725518-001	.248498-007	-.338615-007	.420013-007	-147.535	5.3455	306.2736	
	.457717+000	.728479-001	.214096-007	-.320440-007	.385382-007	-148.282	5.3014	303.7481	
	.460064+000	.732215-001	.179514-007	-.297776-007	.347701-007	-149.176	5.2549	301.0836	
	.462436+000	.735989-001	.152173-007	-.276135-007	.315289-007	-150.026	5.2161	298.8584	

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN) CURRENT TIME = 084950
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT THE CPU TIMER = 50 SEC

PITCH RATE ERROR / CREW MOTION FORCE

	FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG	
	.464832+000	.739803-001	.130333-007	-.255978-007	.287248-007	-150.835	5.1833	296.9832	
	.467253+000	.743656-001	.112696-007	-.237442-007	.262829-007	-151.607	5.1555	295.3902	
	.477194+000	.759478-001	.682530-008	-.178155-007	.190782-007	-154.389	5.0782	290.9623	
	.487568+000	.775989-001	.456061-008	-.136716-007	.144122-007	-156.825	5.0344	288.4478	
	.498403+000	.793233-001	.326896-008	-.106615-007	.111514-007	-159.053	5.0099	287.0463	
	.509730+000	.811261-001	.246919-008	-.838093-008	.873710-008	-161.173	4.9989	286.4160	
	.534003+000	.849892-001	.158009-008	-.513176-008	.536951-008	-165.401	5.0111	287.1137	
	.542715+000	.863758-001	.139657-008	-.429060-008	.451217-008	-166.912	5.0271	288.0298	
	.555050+000	.883389-001	.120187-008	-.328335-008	.349641-008	-169.128	5.0633	290.1051	
	.567384+000	.903020-001	.105943-008	-.243694-008	.265727-008	-171.511	5.1225	293.4963	
	.579719+000	.922651-001	.952606-009	-.170995-008	.195739-008	-174.166	5.2207	299.1220	
	.592053+000	.942282-001	.871006-009	-.107386-008	.138269-008	-177.185	5.3939	309.0453	
	.595137+000	.947190-001	.853696-009	-.926539-009	.125987-008	-177.993	5.4569	312.6569	
	.598220+000	.952097-001	.837446-009	-.783349-009	.114671-008	-178.811	5.5311	316.9116	
	.601304+000	.957005-001	.822183-009	-.644058-009	.104441-008	-179.623	5.6187	321.9266	
	.604388+000	.961913-001	.807841-009	-.508447-009	.954529-009	-180.404	5.7214	327.8141	
	.606854+000	.965839-001	.796989-009	-.402469-009	.892845-009	-180.984	5.8156	333.2068	
	.609321+000	.969765-001	.786657-009	-.298619-009	.841429-009	-181.500	5.9204	339.2130	
	.610555+000	.971728-001	.781678-009	-.247462-009	.819914-009	-181.725	5.9766	342.4334	
	.611788+000	.973691-001	.776820-009	-.196803-009	.801361-009	-181.923	6.0351	345.7836	
	.613022+000	.975654-001	.772078-009	-.146630-009	.785879-009	-182.093	6.0955	349.2467	
	.614255+000	.977627-001	.767451-009	-.969340-010	.773549-009	-182.230	6.1575	352.8013	
	.615489+000	.979580-001	.762936-009	-.477040-010	.764426-009	-182.333	6.2207	356.4221	
	.615982+000	.980366-001	.761160-009	-.281403-010	.761680-009	-182.365	6.2462	357.8827	
	.616414+000	.981053-001	.759620-009	-.110814-010	.759701-009	-182.387	6.2686	359.1642	
	.616568+000	.981298-001	.759074-009	-.500235-011	.759090-009	-182.394	6.2766	359.6224	
	.616660+000	.981445-001	.758746-009	-.135826-011	.758748-009	-182.398	6.2814	359.8974	
	.616673+000	.981465-001	.758703-009	-.872568-012	.758703-009	-182.399	6.2820	359.9341	
	.616685+000	.981485-001	.758659-009	-.386920-012	.758659-009	-182.399	6.2827	359.9708	
	.616697+000	.981504-001	.758616-009	.986777-013	.758616-009	-182.400	.0001	.0075	
	.616710+000	.981524-001	.758572-009	.584235-012	.758572-009	-182.400	.0008	.0441	
	.616716+000	.981534-001	.758550-009	.826993-012	.758551-009	-182.400	.0011	.0625	
********	.616722+000	.981544-001	.758529-009	.106975-011	.758529-009	-182.401	.0014	.0808	********
	.616728+000	.981553-001	.758507-009	.131249-011	.758508-009	-182.401	.0017	.0991	
	.616734+000	.981563-001	.758485-009	.155522-011	.758487-009	-182.401	.0021	.1175	
	.616747+000	.981583-001	.758442-009	.204068-011	.758444-009	-182.402	.0027	.1542	
	.616759+000	.981602-001	.758398-009	.252610-011	.758402-009	-182.402	.0033	.1908	
	.616771+000	.981622-001	.758354-009	.301150-011	.758360-009	-182.402	.0040	.2275	
	.616794+000	.981642-001	.758311-009	.349687-011	.758319-009	-182.403	.0046	.2642	
	.616876+000	.981789-001	.757985-009	.713638-011	.758019-009	-182.406	.0094	.5394	
	.617031+000	.982035-001	.757443-009	.131991-010	.757558-009	-182.412	.0174	.9983	

RUN NO. IOG 2 DATE 091275 PAGE NO. 38

RUN BY

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN) CURRENT TIME = 084951

SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT THE CPU TIMER = 51 SEC

PITCH RATE ERROR / CREW MOTION FORCE

FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG
.617463+000	.982723-001	.755932-009	.301538-010	.756533-009	-182.423	.0399	2.2843
.617958+000	.983511-001	.754219-009	.494932-010	.755841-009	-182.431	.0655	3.7545
.619199+000	.985486-001	.749996-009	.976695-010	.756329-009	-182.426	.1295	7.4197
.620445+000	.987468-001	.745859-009	.145604-009	.759939-009	-182.384	.1928	11.0461
.621696+000	.989459-001	.741807-009	.193301-009	.766579-009	-182.309	.2549	14.6054
.622952+000	.991458-001	.737837-009	.240767-009	.776126-009	-182.201	.3154	18.0722
.624213+000	.993465-001	.733949-009	.288005-009	.788434-009	-182.065	.3739	21.4253
.626750+000	.997504-001	.726413-009	.381820-009	.820647-009	-181.717	.4839	27.7275
.629308+000	.100158+000	.719188-009	.474785-009	.861773-009	-181.292	.5835	33.4315
.632535+000	.100671+000	.710582-009	.589852-009	.923500-009	-180.691	.6928	39.6960
.635796+000	.101190+000	.702431-009	.703717-009	.994297-009	-180.050	.7863	45.0524
.639090+000	.101714+000	.694720-009	.816449-009	.107202-008	-179.396	.8658	49.6054
.642419+000	.102244+000	.687435-009	.928113-009	.115497-008	-178.749	.9333	53.4734
.656087+000	.104420+000	.662280-009	.136533-008	.151748-008	-176.378	1.1192	64.1234
.670350+000	.106690+000	.642977-009	.179022-008	.190219-008	-174.415	1.2260	70.2437
.685247+000	.109060+000	.628974-009	.220621-008	.229412-008	-172.788	1.2931	74.0876
.700820+000	.111539+000	.619880-009	.261645-008	.268887-008	-171.409	1.3382	76.6714
.734193+000	.116850+000	.615535-009	.343149-008	.348626-008	-169.153	1.3933	79.8306
.770903+000	.122693+000	.629401-009	.425848-008	.430474-008	-167.321	1.4241	81.5926
.822296+000	.130872+000	.674708-009	.534579-008	.538820-008	-165.371	1.4452	82.8066
.881031+000	.140221+000	.758944-009	.654458-008	.658844-008	-163.624	1.4553	83.3853
.890000+000	.141648+000	.774795-009	.672661-008	.677109-008	-163.387	1.4561	83.4295
.100000+001	.159155+000	.104027-008	.900825-008	.906811-008	-160.850	1.4558	83.4127
.110000+001	.175070+000	.142541-008	.112738-007	.113636-007	-158.890	1.4450	82.7940
.118861+001	.189173+000	.193664-008	.135501-007	.136878-007	-157.273	1.4288	81.8662
.138671+001	.220702+000	.419234-008	.201788-007	.206097-007	-153.719	1.3660	78.2632
.148576+001	.236466+000	.650149-008	.247375-007	.255776-007	-151.843	1.3138	75.2746
.158481+001	.252231+000	.105475-007	.305043-007	.322763-007	-149.822	1.2379	70.9261
.166405+001	.264842+000	.161372-007	.360606-007	.395067-007	-148.067	1.1500	65.8914
.174329+001	.277454+000	.255533-007	.419236-007	.490974-007	-146.179	1.0234	58.6369
.178291+001	.283759+000	.324537-007	.443473-007	.549538-007	-145.200	.9390	53.8030
.182253+001	.290065+000	.412226-007	.456287-007	.614922-007	-144.224	.8361	47.9042
.186215+001	.296371+000	.518813-007	.446861-007	.684728-007	-143.290	.7110	40.7388
.190177+001	.302677+000	.637495-007	.401106-007	.753184-007	-142.462	.5616	32.1777
.191168+001	.304253+000	.667178-007	.382422-007	.769008-007	-142.281	.5205	29.8211
.192158+001	.305830+000	.696106-007	.360577-007	.783951-007	-142.114	.4779	27.3838
.193149+001	.307406+000	.723824-007	.335548-007	.797818-007	-141.962	.4341	24.8713
.194139+001	.308983+000	.749850-007	.307392-007	.810410-007	-141.826	.3890	22.2906
.194932+001	.310244+000	.769125-007	.282715-007	.819440-007	-141.730	.3522	20.1824
.195724+001	.311505+000	.786761-007	.256255-007	.827441-007	-141.645	.3149	18.0409

ORIGINAL PAGE IS OF POOR QUALITY

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN) CURRENT TIME = 084951
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT THE CPU TIMER = 51 SEC

PITCH RATE ERROR / CREW MOTION FORCE

	FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG	
	.196120+001	.312135+000	.794891-007	.242405-007	.831031-007	-141.608	.2960	16.9593	
	.196517+001	.312766+000	.802527-007	.228174-007	.834334-007	-141.573	.2770	15.8715	
	.196913+001	.313397+000	.809644-007	.213588-007	.837342-007	-141.542	.2579	14.7782	
	.197309+001	.314027+000	.816217-007	.198674-007	.840048-007	-141.514	.2388	13.6802	
	.197705+001	.314658+000	.822225-007	.183463-007	.842445-007	-141.489	.2195	12.5784	
	.197864+001	.314910+000	.824466-007	.177303-007	.843315-007	-141.480	.2118	12.1367	
	.198002+001	.315131+000	.826350-007	.171879-007	.844036-007	-141.473	.2051	11.7499	
	.198052+001	.315210+000	.827005-007	.169935-007	.844283-007	-141.470	.2027	11.6117	
	.198082+001	.315257+000	.827393-007	.168767-007	.844430-007	-141.469	.2012	11.5287	
	.198086+001	.315263+000	.827445-007	.168611-007	.844449-007	-141.469	.2010	11.5177	
	.198090+001	.315269+000	.827496-007	.168455-007	.844468-007	-141.468	.2008	11.5066	
	.198094+001	.315276+000	.827547-007	.168299-007	.844488-007	-141.468	.2006	11.4956	
	.198098+001	.315282+000	.827599-007	.168144-007	.844507-007	-141.468	.2004	11.4845	
	.198100+001	.315285+000	.827624-007	.168066-007	.844517-007	-141.468	.2003	11.4790	
********	.198101+001	.315288+000	.827650-007	.167988-007	.844526-007	-141.468	.2002	11.4734	********
	.198103+001	.315291+000	.827676-007	.167910-007	.844536-007	-141.468	.2002	11.4679	
	.198105+001	.315295+000	.827701-007	.167832-007	.844545-007	-141.468	.2001	11.4624	
	.198109+001	.315301+000	.827753-007	.167676-007	.844565-007	-141.467	.1999	11.4513	
	.198113+001	.315307+000	.827804-007	.167520-007	.844584-007	-141.467	.1997	11.4402	
	.198117+001	.315314+000	.827855-007	.167364-007	.844603-007	-141.467	.1995	11.4292	
	.198121+001	.315320+000	.827906-007	.167207-007	.844622-007	-141.467	.1993	11.4181	
	.198151+001	.315367+000	.828286-007	.166036-007	.844764-007	-141.465	.1978	11.3351	
	.198201+001	.315446+000	.828914-007	.164079-007	.844997-007	-141.463	.1954	11.1967	
	.198340+001	.315667+000	.830621-007	.158578-007	.845623-007	-141.456	.1886	10.8086	
	.198498+001	.315920+000	.832484-007	.152250-007	.846292-007	-141.450	.1809	10.3641	
	.198897+001	.316555+000	.836717-007	.136250-007	.847738-007	-141.435	.1614	9.2488	
	.199297+001	.317191+000	.840330-007	.120025-007	.848859-007	-141.423	.1419	8.1286	
	.199699+001	.317831+000	.843308-007	.103608-007	.849649-007	-141.415	.1222	7.0042	
	.200103+001	.318473+000	.845636-007	.870374-008	.850103-007	-141.411	.1026	5.8765	
	.200508+001	.319118+000	.847304-007	.703520-008	.850220-007	-141.409	.0828	4.7464	
	.201323+001	.320415+000	.848634-007	.367942-008	.849431-007	-141.417	.0433	2.4826	
	.202144+001	.321723+000	.847277-007	.325468-009	.847283-007	-141.439	.0038	.2201	
	.203181+001	.323373+000	.841850-007	-.381586-008	.842715-007	-141.486	6.2379	357.4047	
	.204228+001	.325040+000	.832440-007	-.784485-008	.836128-007	-141.555	6.1892	354.6164	
	.205287+001	.326724+000	.819320-007	-.117072-007	.827642-007	-141.643	6.1413	351.8681	
	.206356+001	.328425+000	.802854-007	-.153564-007	.817408-007	-141.751	6.0942	349.1717	
	.210746+001	.335413+000	.712578-007	-.272221-007	.762805-007	-142.352	5.9183	339.0920	
	.215328+001	.342705+000	.605087-007	-.343724-007	.695899-007	-143.149	5.7666	330.4009	
	.220113+001	.350320+000	.501942-007	-.375968-007	.627134-007	-144.053	5.6403	323.1658	
	.225115+001	.358282+000	.413090-007	-.381935-007	.562599-007	-144.996	5.5370	317.2442	
	.235835+001	.375343+000	.282659-007	-.355596-007	.454252-007	-146.854	5.3840	308.4807	

RUN NO. IOG 2

DATE 091275

RUN BY

CURRENT TIME = 084952

THE CPU TIMER = 52 SEC

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

PITCH RATE ERROR / CREW MOTION FORCE

	FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG	
	.247627+001	.394110+000	.200472-007	-.313876-007	.372434-007	-148.579	5.2808	302.5663	
	.264135+001	.420384+000	.138119-007	-.263783-007	.297756-007	-150.523	5.1947	297.6369	
	.273587+001	.435427+000	.116481-007	-.240996-007	.267670-007	-151.448	5.1626	295.7960	
	.287266+001	.457198+000	.948134-008	-.214179-007	.234227-007	-152.607	5.1291	293.8781	
	.300946+001	.478970+000	.800897-008	-.192931-007	.208894-007	-153.601	5.1059	292.5443	
	.307785+001	.489855+000	.744229-008	-.183915-007	.198402-007	-154.049	5.0969	292.0312	
	.314625+001	.500741+000	.695839-008	-.175773-007	.189045-007	-154.469	5.0893	291.5973	
	.321465+001	.511627+000	.654143-008	-.168387-007	.180646-007	-154.863	5.0829	291.2300	
	.328304+001	.522512+000	.617924-008	-.161658-007	.173065-007	-155.236	5.0775	290.9189	
	.330014+001	.525234+000	.609609-008	-.160068-007	.171284-007	-155.326	5.0763	290.8490	
	.331724+001	.527955+000	.601563-008	-.158513-007	.169544-007	-155.414	5.0751	290.7819	
	.333434+001	.530677+000	.593774-008	-.156992-007	.167845-007	-155.502	5.0740	290.7176	
	.335144+001	.533398+000	.586231-008	-.155503-007	.166186-007	-155.588	5.0729	290.6560	
	.336512+001	.535575+000	.580367-008	-.154334-007	.164886-007	-155.656	5.0721	290.6085	
	.337880+001	.537752+000	.574648-008	-.153185-007	.163609-007	-155.724	5.0713	290.5627	
	.338564+001	.538841+000	.571842-008	-.152618-007	.162979-007	-155.757	5.0709	290.5404	
	.339248+001	.539929+000	.569070-008	-.152055-007	.162355-007	-155.791	5.0705	290.5185	
	.339932+001	.541018+000	.566332-008	-.151497-007	.161737-007	-155.824	5.0701	290.4969	
	.340616+001	.542107+000	.563627-008	-.150944-007	.161124-007	-155.857	5.0698	290.4757	
	.341300+001	.543195+000	.560955-008	-.150395-007	.160516-007	-155.890	5.0694	290.4549	
	.341573+001	.543631+000	.559896-008	-.150177-007	.160274-007	-155.903	5.0692	290.4467	
	.341813+001	.544012+000	.558973-008	-.149986-007	.160064-007	-155.914	5.0691	290.4395	
	.341898+001	.544148+000	.558644-008	-.149919-007	.159989-007	-155.918	5.0691	290.4370	
	.341949+001	.544229+000	.558447-008	-.149878-007	.159944-007	-155.921	5.0691	290.4354	
	.341956+001	.544240+000	.558421-008	-.149872-007	.159938-007	-155.921	5.0690	290.4352	
	.341963+001	.544251+000	.558395-008	-.149867-007	.159932-007	-155.921	5.0690	290.4350	
	.341970+001	.544262+000	.558368-008	-.149862-007	.159926-007	-155.922	5.0690	290.4348	
	.341977+001	.544273+000	.558342-008	-.149856-007	.159920-007	-155.922	5.0690	290.4346	
	.341980+001	.544278+000	.558329-008	-.149853-007	.159917-007	-155.922	5.0690	290.4345	
********	.341984+001	.544284+000	.558316-008	-.149851-007	.159914-007	-155.922	5.0690	290.4344	********
********	.341984+001	.544284+000	.558316-008	-.149851-007	.159914-007	-155.922	5.0690	290.4344	********
	.341987+001	.544289+000	.558303-008	-.149848-007	.159911-007	-155.922	5.0690	290.4343	
	.341990+001	.544295+000	.558290-008	-.149845-007	.159908-007	-155.923	5.0690	290.4342	
	.341997+001	.544306+000	.558263-008	-.149840-007	.159902-007	-155.923	5.0690	290.4340	
	.342004+001	.544316+000	.558237-008	-.149835-007	.159896-007	-155.923	5.0690	290.4338	
	.342011+001	.544327+000	.558211-008	-.149829-007	.159890-007	-155.924	5.0690	290.4336	
	.342018+001	.544338+000	.558185-008	-.149824-007	.159884-007	-155.924	5.0690	290.4334	
	.342069+001	.544420+000	.557988-008	-.149783-007	.159839-007	-155.926	5.0690	290.4319	
	.342155+001	.544556+000	.557661-008	-.149715-007	.159764-007	-155.930	5.0689	290.4294	
	.342394+001	.544938+000	.556746-008	-.149526-007	.159555-007	-155.942	5.0688	290.4223	
	.342669+001	.545375+000	.555703-008	-.149310-007	.159316-007	-155.955	5.0687	290.4143	

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084952
THE CPU TIMER = 52 SEC

PITCH RATE ERROR / CREW MOTION FORCE

FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG
.343357+001	.546470+000	.553111-008	-.148771-007	.158720-007	-155.987	5.0683	290.3944
.344048+001	.547569+000	.550539-008	-.148235-007	.158128-007	-156.020	5.0680	290.3748
.344742+001	.548673+000	.547989-008	-.147700-007	.157538-007	-156.052	5.0677	290.3555
.345438+001	.549782+000	.545458-008	-.147168-007	.156952-007	-156.085	5.0673	290.3365
.346137+001	.550894+000	.542948-008	-.146639-007	.156367-007	-156.117	5.0670	290.3177
.347544+001	.553134+000	.537988-008	-.145585-007	.155208-007	-156.182	5.0664	290.2810
.348963+001	.555392+000	.533105-008	-.144541-007	.154059-007	-156.246	5.0657	290.2453
.350752+001	.558240+000	.527110-008	-.143247-007	.152637-007	-156.327	5.0650	290.2022
.352560+001	.561117+000	.521232-008	-.141966-007	.151232-007	-156.407	5.0643	290.1608
.354387+001	.564025+000	.515468-008	-.140698-007	.149844-007	-156.487	5.0636	290.1210
.356233+001	.566962+000	.509816-008	-.139443-007	.148471-007	-156.567	5.0629	290.0828
.363812+001	.579025+000	.488269-008	-.134545-007	.143131-007	-156.885	5.0605	289.9460
.371721+001	.591613+000	.468307-008	-.129833-007	.138021-007	-157.201	5.0586	289.8343
.379982+001	.604760+000	.449790-008	-.125297-007	.133126-007	-157.515	5.0570	289.7470
.388618+001	.618504+000	.432595-008	-.120926-007	.128431-007	-157.827	5.0559	289.6839
.407123+001	.647957+000	.401742-008	-.112639-007	.119589-007	-158.446	5.0550	289.6294
.427479+001	.680355+000	.375009-008	-.104902-007	.111404-007	-159.062	5.0557	289.6711
.455978+001	.725712+000	.346513-008	-.959099-008	.101978-007	-159.830	5.0591	289.8643
.488548+001	.777548+000	.322707-008	-.875787-008	.933350-008	-160.599	5.0654	290.2277
.515050+001	.819727+000	.308131-008	-.819401-008	.875422-008	-161.156	5.0721	290.6085
.549386+001	.874376+000	.293811-008	-.757856-008	.812816-008	-161.800	5.0822	291.1906
.576856+001	.918094+000	.285155-008	-.716009-008	.770702-008	-162.262	5.0914	291.7152
.604325+001	.961813+000	.278427-008	-.679461-008	.734295-008	-162.683	5.1013	292.2826
.618060+001	.983673+000	.275667-008	-.662899-008	.717932-008	-162.878	5.1065	292.5800
.631794+001	.100553+001	.273257-008	-.647359-008	.702668-008	-163.065	5.1118	292.8851
.645529+001	.102739+001	.271164-008	-.632767-008	.688421-008	-163.243	5.1172	293.1969
.659264+001	.104925+001	.269359-008	-.619057-008	.675120-008	-163.412	5.1228	293.5144
.662697+001	.105472+001	.268950-008	-.615761-008	.671934-008	-163.453	5.1242	293.5945
.666131+001	.106018+001	.268556-008	-.612515-008	.668803-008	-163.494	5.1254	293.6749
.669565+001	.106565+001	.268177-008	-.609319-008	.665725-008	-163.534	5.1270	293.7555
.672998+001	.107111+001	.267814-008	-.606173-008	.662699-008	-163.574	5.1284	293.8364
.675745+001	.107548+001	.267534-008	-.603690-008	.660315-008	-163.605	5.1295	293.9012
.678492+001	.107985+001	.267263-008	-.601238-008	.657964-008	-163.636	5.1307	293.9661
.679866+001	.108204+001	.267131-008	-.600024-008	.656801-008	-163.651	5.1312	293.9986
.681239+001	.108423+001	.267001-008	-.598816-008	.655645-008	-163.667	5.1318	294.0312
.682613+001	.108641+001	.266873-008	-.597617-008	.654498-008	-163.682	5.1324	294.0637
.683986+001	.108860+001	.266748-008	-.596425-008	.653358-008	-163.697	5.1329	294.0963
.685360+001	.109078+001	.266624-008	-.595240-008	.652226-008	-163.712	5.1335	294.1289
.685909+001	.109166+001	.266576-008	-.594768-008	.651775-008	-163.718	5.1337	294.1420
.686390+001	.109242+001	.266533-008	-.594356-008	.651382-008	-163.723	5.1339	294.1534

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 084953
THE CPU TIMER = 53 SEC

PITCH RATE ERROR / CREW MOTION FORCE

	FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG	
	.686561+001	.109270+001	.266518-008	-.594209-008	.651242-008	-163.725	5.1340	294.1575	
	.686664+001	.109286+001	.266509-008	-.594121-008	.651158-008	-163.726	5.1341	294.1599	
	.686678+001	.109288+001	.266508-008	-.594109-008	.651147-008	-163.726	5.1341	294.1602	
	.686692+001	.109290+001	.266507-008	-.594097-008	.651136-008	-163.727	5.1341	294.1606	
	.686706+001	.109293+001	.266506-008	-.594086-008	.651124-008	-163.727	5.1341	294.1609	
	.686719+001	.109295+001	.266504-008	-.594074-008	.651113-008	-163.727	5.1341	294.1612	
	.686726+001	.109296+001	.266504-008	-.594068-008	.651108-008	-163.727	5.1341	294.1614	
••••••••	.686733+001	.109297+001	.266503-008	-.594062-008	.651102-008	-163.727	5.1341	294.1615	••••••••
	.686740+001	.109298+001	.266503-008	-.594056-008	.651096-008	-163.727	5.1341	294.1617	
	.686747+001	.109299+001	.266502-008	-.594050-008	.651091-008	-163.727	5.1341	294.1619	
	.686760+001	.109301+001	.266501-008	-.594039-008	.651080-008	-163.727	5.1341	294.1622	
	.686774+001	.109304+001	.266500-008	-.594027-008	.651068-008	-163.727	5.1341	294.1625	
	.686788+001	.109306+001	.266498-008	-.594015-008	.651057-008	-163.728	5.1341	294.1628	
	.686802+001	.109308+001	.266497-008	-.594003-008	.651046-008	-163.728	5.1341	294.1632	
	.686905+001	.109324+001	.266488-008	-.593915-008	.650962-008	-163.729	5.1342	294.1656	
	.687077+001	.109352+001	.266473-008	-.593769-008	.650822-008	-163.731	5.1342	294.1697	
	.687558+001	.109428+001	.266431-008	-.593358-008	.650430-008	-163.736	5.1344	294.1811	
	.687955+001	.109492+001	.266397-008	-.593020-008	.650108-008	-163.740	5.1346	294.1906	
	.688438+001	.109568+001	.266356-008	-.592611-008	.649718-008	-163.746	5.1348	294.2021	
	.688610+001	.109596+001	.266341-008	-.592465-008	.649578-008	-163.747	5.1349	294.2061	
	.688713+001	.109612+001	.266332-008	-.592377-008	.649495-008	-163.748	5.1349	294.2086	
	.688727+001	.109614+001	.266331-008	-.592366-008	.649484-008	-163.749	5.1349	294.2089	
	.688741+001	.109616+001	.266330-008	-.592354-008	.649473-008	-163.749	5.1349	294.2093	
	.688754+001	.109619+001	.266329-008	-.592342-008	.649462-008	-163.749	5.1349	294.2096	
	.688768+001	.109621+001	.266327-008	-.592331-008	.649450-008	-163.749	5.1349	294.2099	
	.688775+001	.109622+001	.266327-008	-.592325-008	.649445-008	-163.749	5.1349	294.2101	
••••••••	.688782+001	.109623+001	.266326-008	-.592319-008	.649439-008	-163.749	5.1349	294.2102	••••••••
	.688789+001	.109624+001	.266326-008	-.592313-008	.649434-008	-163.749	5.1349	294.2104	
	.688796+001	.109625+001	.266325-008	-.592307-008	.649428-008	-163.749	5.1349	294.2106	
	.688810+001	.109627+001	.266324-008	-.592296-008	.649417-008	-163.750	5.1349	294.2109	
	.688823+001	.109630+001	.266323-008	-.592284-008	.649406-008	-163.750	5.1350	294.2112	
	.688837+001	.109632+001	.266322-008	-.592272-008	.649395-008	-163.750	5.1350	294.2116	
	.688851+001	.109634+001	.266320-008	-.592261-008	.649384-008	-163.750	5.1350	294.2119	
	.688954+001	.109650+001	.266312-008	-.592173-008	.649300-008	-163.751	5.1350	294.2143	
	.689127+001	.109678+001	.266297-008	-.592027-008	.649161-008	-163.753	5.1351	294.2184	
	.689609+001	.109755+001	.266256-008	-.591619-008	.648773-008	-163.758	5.1353	294.2299	
	.690066+001	.109827+001	.266218-008	-.591235-008	.648406-008	-163.763	5.1355	294.2408	
	.690550+001	.109904+001	.266177-008	-.590828-008	.648018-008	-163.768	5.1357	294.2523	
	.690723+001	.109932+001	.266163-008	-.590683-008	.647880-008	-163.770	5.1357	294.2564	
	.690826+001	.109948+001	.266154-008	-.590596-008	.647797-008	-163.771	5.1358	294.2589	
	.690840+001	.109951+001	.266153-008	-.590584-008	.64[illegible]36-008	-163.771	5.1358	294.2592	
	.690854+001	.109953+001	.266152-008	-.590573-008	.647775-008	-163.772	5.1358	294.2595	

CURRENT TIME = 084954
THE CPU TIMER = 53 SEC

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

PITCH RATE ERROR / CREW MOTION FORCE

	FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG	
	.690868+001	.109955+001	.266151-008	-.590561-008	.647764-008	-163.772	5.1358	294.2599	
	.690882+001	.109957+001	.266150-008	-.590549-008	.647753-008	-163.772	5.1358	294.2602	
	.690888+001	.109958+001	.266149-008	-.590544-008	.647748-008	-163.772	5.1358	294.2604	
********	.690895+001	.109959+001	.266149-008	-.590538-008	.647742-008	-163.772	5.1358	294.2605	********
********	.690895+001	.109959+001	.266149-008	-.590538-008	.647742-008	-163.772	5.1358	294.2605	********
	.690902+001	.109961+001	.266148-008	-.590532-008	.647737-008	-163.772	5.1358	294.2607	
	.690909+001	.109962+001	.266147-008	-.590526-008	.647731-008	-163.772	5.1358	294.2608	
	.690923+001	.109964+001	.266146-008	-.590515-008	.647720-008	-163.772	5.1358	294.2612	
	.690937+001	.109966+001	.266145-008	-.590503-008	.647709-008	-163.772	5.1358	294.2615	
	.690951+001	.109968+001	.266144-008	-.590491-008	.647698-008	-163.773	5.1358	294.2618	
	.690964+001	.109970+001	.266143-008	-.590480-008	.647687-008	-163.773	5.1358	294.2622	
	.691068+001	.109987+001	.266134-008	-.590393-008	.647604-008	-163.774	5.1359	294.2646	
	.691241+001	.110014+001	.266120-008	-.590248-008	.647466-008	-163.776	5.1360	294.2687	
	.691725+001	.110092+001	.266080-008	-.589843-008	.647081-008	-163.781	5.1362	294.2803	
	.692280+001	.110180+001	.266035-008	-.589380-008	.646640-008	-163.787	5.1364	294.2935	
	.693670+001	.110401+001	.265923-008	-.588225-008	.645541-008	-163.802	5.1370	294.3266	
	.695066+001	.110623+001	.265812-008	-.587073-008	.644446-008	-163.816	5.1375	294.3598	
	.696467+001	.110846+001	.265703-008	-.585923-008	.643354-008	-163.831	5.1381	294.3932	
	.697874+001	.111070+001	.265596-008	-.584776-008	.642265-008	-163.846	5.1387	294.4268	
	.699287+001	.111295+001	.265490-008	-.583631-008	.641179-008	-163.860	5.1393	294.4604	
	.702129+001	.111747+001	.265283-008	-.581351-008	.639018-008	-163.890	5.1405	294.5282	
	.704995+001	.112203+001	.265083-008	-.579081-008	.636871-008	-163.919	5.1417	294.5966	
	.708611+001	.112779+001	.264841-008	-.576260-008	.634206-008	-163.955	5.1432	294.6828	
	.712263+001	.113360+001	.264609-008	-.573457-008	.631562-008	-163.992	5.1447	294.7699	
	.715954+001	.113948+001	.264387-008	-.570671-008	.628941-008	-164.028	5.1462	294.8579	
	.719683+001	.114541+001	.264175-008	-.567905-008	.626342-008	-164.064	5.1478	294.9467	
	.734995+001	.116978+001	.263421-008	-.557030-008	.616176-008	-164.206	5.1541	295.3096	
	.750973+001	.119521+001	.262612-008	-.546480-008	.606392-008	-164.345	5.1607	295.6837	
	.767661+001	.122177+001	.262338-008	-.536284-008	.597011-008	-164.480	5.1673	296.0668	
	.785108+001	.124954+001	.261980-008	-.526472-008	.588053-008	-164.612	5.1741	296.4556	
	.822494+001	.130904+001	.261518-008	-.508122-008	.571471-008	-164.860	5.1877	297.2338	
	.863619+001	.137449+001	.261150-008	-.491685-008	.556734-008	-165.087	5.2006	297.9742	
	.921194+001	.146613+001	.260175-008	-.474147-008	.540838-008	-165.339	5.2142	298.7545	
	.986993+001	.157085+001	.257583-008	-.460077-008	.527276-008	-165.559	5.2228	299.2431	
	.111392+002	.177286+001	.247024-008	-.443805-008	.507921-008	-165.884	5.2203	299.1005	
	.119348+002	.189949+001	.237287-008	-.437297-008	.497527-008	-166.064	5.2095	298.4853	
	.127305+002	.202612+001	.226033-008	-.432018-008	.487577-008	-166.239	5.1944	297.6187	
	.133670+002	.212743+001	.216362-008	-.428263-008	.479815-008	-166.379	5.1802	296.8033	
	.140035+002	.222873+001	.206344-008	-.424751-008	.472219-008	-166.517	5.1646	295.9105	
	.143218+002	.227939+001	.201254-008	-.423056-008	.468487-008	-166.586	5.1564	295.4411	
	.146401+002	.233004+001	.196129-008	-.421393-008	.464800-008	-166.655	5.1480	294.9586	

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN) CURRENT TIME = 084954
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT THE CPU TIMER = 53 SEC

PITCH RATE ERROR / CREW MOTION FORCE

	FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG	
	.149583+002	.238069+001	.190979-008	-.419756-008	.461159-008	-166.723	5.1394	294.4644	
	.152766+002	.243135+001	.185812-008	-.418138-008	.457565-008	-166.791	5.1306	293.9594	
	.153562+002	.244401+001	.184519-008	-.417736-008	.456673-008	-166.808	5.1283	293.8316	
	.154357+002	.245667+001	.183225-008	-.417335-008	.455785-008	-166.825	5.1261	293.7032	
	.155153+002	.246934+001	.181931-008	-.416935-008	.454899-008	-166.842	5.1238	293.5742	
	.155949+002	.248200+001	.180636-008	-.416535-008	.454016-008	-166.859	5.1216	293.4446	
	.156585+002	.249213+001	.179600-008	-.416216-008	.453312-008	-166.872	5.1198	293.3405	
	.157222+002	.250226+001	.178564-008	-.415897-008	.452610-008	-166.886	5.1179	293.2361	
	.157540+002	.250733+001	.178046-008	-.415738-008	.452259-008	-166.892	5.1170	293.1837	
	.157858+002	.251239+001	.177528-008	-.415579-008	.451909-008	-166.899	5.1161	293.1313	
	.158176+002	.251746+001	.177009-008	-.415420-008	.451560-008	-166.906	5.1152	293.0787	
	.158495+002	.252252+001	.176491-008	-.415261-008	.451211-008	-166.912	5.1143	293.0261	
	.158813+002	.252759+001	.175973-008	-.415102-008	.450862-008	-166.919	5.1133	292.9734	
	.158940+002	.252961+001	.175766-008	-.415039-008	.450722-008	-166.922	5.1130	292.9523	
	.159052+002	.253139+001	.175584-008	-.414983-008	.450601-008	-166.924	5.1127	292.9338	
	.159091+002	.253202+001	.175520-008	-.414963-008	.450557-008	-166.925	5.1125	292.9272	
	.159115+002	.253240+001	.175481-008	-.414951-008	.450531-008	-166.926	5.1125	292.9232	
	.159118+002	.253245+001	.175476-008	-.414950-008	.450527-008	-166.926	5.1125	292.9227	
	.159122+002	.253250+001	.175470-008	-.414948-008	.450524-008	-166.926	5.1125	292.9222	
	.159125+002	.253255+001	.175465-008	-.414947-008	.450521-008	-166.926	5.1124	292.9216	
	.159128+002	.253260+001	.175460-008	-.414945-008	.450517-008	-166.926	5.1124	292.9211	
	.159130+002	.253263+001	.175458-008	-.414944-008	.450515-008	-166.926	5.1124	292.9209	
********	.159131+002	.253265+001	.175455-008	-.414943-008	.450514-008	-166.926	5.1124	292.9206	********
********	.159131+002	.253265+001	.175455-008	-.414943-008	.450514-008	-166.926	5.1124	292.9206	********
	.159133+002	.253268+001	.175452-008	-.414943-008	.450512-008	-166.926	5.1124	292.9203	
	.159134+002	.253270+001	.175450-008	-.414942-008	.450510-008	-166.926	5.1124	292.9201	
	.159138+002	.253275+001	.175445-008	-.414940-008	.450507-008	-166.926	5.1124	292.9195	
	.159141+002	.253280+001	.175439-008	-.414939-008	.450503-008	-166.926	5.1124	292.9190	
	.159144+002	.253285+001	.175434-008	-.414937-008	.450500-008	-166.926	5.1124	292.9185	
	.159147+002	.253291+001	.175429-008	-.414935-008	.450496-008	-166.926	5.1124	292.9180	
	.159171+002	.253329+001	.175390-008	-.414924-008	.450470-008	-166.927	5.1123	292.9140	
	.159211+002	.253392+001	.175325-008	-.414904-008	.450426-008	-166.928	5.1122	292.9074	
	.159322+002	.253569+001	.175144-008	-.414848-008	.450305-008	-166.930	5.1119	292.8888	
	.159450+002	.253773+001	.174936-008	-.414784-008	.450165-008	-166.933	5.1115	292.8676	
	.159770+002	.254282+001	.17441[illegible]-008	-.414625-008	.449816-008	-166.939	5.1106	292.8143	
	.160092+002	.254794+001	.173891-008	-.414465-008	.449465-008	-166.946	5.1096	292.7607	
	.160415+002	.255308+001	.173365-008	-.414304-008	.449114-008	-166.953	5.1087	292.7068	
	.160739+002	.255823+001	.172838-008	-.414142-008	.448761-008	-166.960	5.1078	292.6527	
	.161064+002	.256341+001	.172308-008	-.413980-008	.448408-008	-166.967	5.1068	292.5982	
	.161719+002	.257383+001	.171242-008	-.413655-008	.447698-008	-166.980	5.1049	292.4882	
	.162379+002	.258434+001	.170167-008	-.413326-008	.446985-008	-166.994	5.1029	292.3771	

ORIGINAL PAGE IS OF POOR QUALITY

VI-74

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN) CURRENT TIME = 084954
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT THE CPU TIMER = 54 SEC

PITCH RATE ERROR / CREW MOTION FORCE

FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG
.163211+002	.259759+001	.168812-008	-.412912-008	.446087-008	-167.012	5.1005	292.2363
.164053+002	.261098+001	.167443-008	-.412494-008	.445184-008	-167.029	5.0980	292.0936
.164903+002	.262451+001	.166060-008	-.412071-008	.444273-008	-167.047	5.0955	291.9488
.165762+002	.263818+001	.164663-008	-.411644-008	.443357-008	-167.065	5.0929	291.8020
.169289+002	.269431+001	.158931-008	-.409889-008	.439623-008	-167.138	5.0823	291.1933
.172969+002	.275286+001	.152961-008	-.408050-008	.435777-008	-167.215	5.0710	290.5489
.176812+002	.281406+001	.146740-008	-.406115-008	.431812-008	-167.294	5.0591	289.8661
.180831+002	.287801+001	.140257-008	-.404069-008	.427719-008	-167.377	5.0465	289.1424
.189442+002	.301506+001	.126448-008	-.399573-008	.419104-008	-167.554	5.0189	287.5603
.198914+002	.316581+001	.111425-008	-.394392-008	.409830-008	-167.748	4.9877	285.7762
.212175+002	.337687+001	.907788-009	-.386589-008	.397104-008	-168.022	4.9430	283.2147

RUN BY

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 085019
THE CPU TIMER = 71 SEC

OUTPUT MATRIX -AR- (30 X 30)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	-6.337-005	0.000	0.000	0.000	0.000	6.337-005	0.000	0.000	0.000	0.000
1	11	0.000	0.000	0.000	-6.244-004	0.000	0.000	0.000	0.000	0.000	0.000
1	21	0.000	0.000	-3.122-004	0.000	0.000	0.000	5.416-022	0.000	3.122-004	0.000
2	1	0.000	-6.504-004	0.000	-2.919-004	0.000	1.094-004	0.000	8.292-006	2.919-004	0.000
2	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.170-005	0.000	2.876-003
3	1	0.000	0.000	-1.400-002	0.000	0.000	0.000	-1.050-002	0.000	0.000	7.000-003
3	11	1.212-002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.379-001	0.000
3	21	0.000	0.000	0.000	0.000	-1.295-002	0.000	0.000	0.000	0.000	0.000
4	1	0.000	-3.080-002	0.000	-1.400-002	0.000	5.250-003	0.000	0.000	1.400-002	0.000
4	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.379-001
5	1	0.000	0.000	0.000	0.000	-1.605-002	0.000	0.000	0.000	0.000	-1.212-002
5	11	7.000-003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	21	1.379-001	0.000	0.000	0.000	2.243-002	0.000	0.000	0.000	0.000	2.053-003
6	1	9.072-001	2.067+001	0.000	9.397+000	0.000	-4.431+000	0.000	0.000	-9.397+000	0.000
6	11	0.000	-2.888-007	0.000	8.939+000	0.000	0.000	0.000	-2.888-007	0.000	-9.259+001
6	21	0.000	0.000	4.470+000	2.454+003	0.000	8.410+003	4.621+004	0.000	5.451+004	0.000
7	1	0.000	0.000	-9.644+000	0.000	-5.628-001	0.000	-8.090+000	0.000	0.000	4.440+000
7	11	8.572+000	0.000	8.447+000	0.000	0.000	0.000	0.000	0.000	9.502+001	0.000
7	21	4.345+000	8.436+000	-1.501-009	0.000	1.151+003	0.000	2.737-024	2.575+004	1.501-009	1.218-001
8	1	0.000	1.269+000	0.000	0.000	0.000	0.000	0.000	-1.269+000	0.000	0.000
8	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-1.250+001	0.000	0.000
8	21	0.000	0.000	2.274-013	0.000	0.000	3.358+003	3.731+004	0.000	-2.274-013	0.000
9	1	2.471-001	8.765+000	0.000	3.984+000	0.000	-1.741+000	0.000	0.000	-3.984+000	0.000
9	11	0.000	-7.866-008	0.000	2.435+000	0.000	0.000	0.000	-7.866-008	0.000	-3.925+001
9	21	0.000	0.000	1.217+000	6.185+002	0.000	2.204+003	1.259+004	0.000	1.374+004	0.000
10	1	0.000	0.000	4.726-002	0.000	-3.138-001	0.000	2.588-002	0.000	0.000	-2.602-001
10	11	9.564-002	0.000	7.425-002	0.000	0.000	0.000	0.000	0.000	-4.656-001	0.000
10	21	2.691+000	9.540-002	-1.674-011	0.000	9.333+000	0.000	2.090-026	1.966+002	1.674-011	4.070-002
11	1	0.000	0.000	1.042-001	0.000	2.121-001	0.000	5.704-002	0.000	0.000	1.092-001
11	11	-1.833-001	0.000	2.077-001	0.000	0.000	0.000	0.000	0.000	-1.026+000	0.000
11	21	-1.835+000	2.123-001	-3.690-011	0.000	2.831+001	0.000	6.732-026	6.333+002	3.690-011	-2.591-002
12	1	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

ORIGINAL PAGE IS OF POOR QUALITY

VI-76

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 085019
THE CPU TIMER = 71 SEC

OUTPUT MATRIX -AR- (30 X 30) CONTINUED

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
13	1	0.000	0.000	0.000	0.000	-6.667-002	0.000	0.000	0.000	0.000	0.000
13	21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.667-002
14	1	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	1	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	1	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000
17	1	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000
18	1	0.000	-1.000+000	0.000	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000
19	1	0.000	0.000	-1.000+000	0.000	0.000	0.000	-7.500-001	0.000	0.000	5.000-001
19	11	8.660-001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	21	0.000	0.000	0.000	0.000	-9.250-001	0.000	0.000	0.000	0.000	0.000
20	1	0.000	-2.200+000	0.000	-1.000+000	0.000	3.750-001	0.000	0.000	1.000+000	0.000
21	1	0.000	0.000	0.000	0.000	-1.147+000	0.000	0.000	0.000	0.000	-8.660-001
21	11	5.000-001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	21	0.000	0.000	0.000	0.000	1.602+000	0.000	0.000	0.000	0.000	1.467-001
22	1	0.000	0.000	0.000	0.000	0.000	-4.039-028	-1.000+000	0.000	0.000	8.674-019
22	11	-4.337-019	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	21	0.000	0.000	0.000	3.503-046	1.000+000	9.571-046	0.000	0.000	0.000	0.000
23	1	0.000	0.000	0.000	0.000	0.000	-2.000+000	0.000	0.000	0.000	0.000
23	21	0.000	0.000	0.000	1.000+000	0.000	1.732+000	0.000	0.000	0.000	0.000
24	1	-3.939-002	4.281-001	0.000	1.946-001	0.000	-3.358-002	0.000	0.000	-1.946-001	0.000
24	11	0.000	1.602-008	0.000	-3.881-001	0.000	0.000	0.000	1.602-008	0.000	-1.917+000
24	21	0.000	0.000	-1.941-001	-1.357+002	0.000	-4.156+002	-2.006+003	0.000	-3.014+003	0.000
25	1	0.000	0.000	-9.194-002	0.000	6.106-001	0.000	-5.035-002	0.000	0.000	5.062-001
25	11	-1.861-001	0.000	-1.834-001	0.000	0.000	0.000	0.000	0.000	9.059-001	0.000
25	21	-5.236+000	-2.014-001	3.258-011	0.000	-5.526+001	0.000	-1.282-025	-1.207+003	-3.258-011	-7.918-002
26	1	0.000	0.000	0.000	0.000	0.000	-1.388-017	0.000	0.000	0.000	0.000
26	21	0.000	0.000	-7.981-009	-5.748+001	0.000	-2.323+002	-1.475+003	0.000	-1.277+003	0.000
27	1	0.000	0.000	0.000	0.000	0.000	3.903-016	0.000	0.000	0.000	0.000
27	21	0.000	0.000	0.000	0.000	0.000	2.000+000	0.000	0.000	0.000	0.000

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 085020
THE CPU TIMER = 72 SEC

OUTPUT MATRIX -AR- (30 X 30) CONTINUED

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
28	1	0.000	0.000	0.000	0.000	0.000	3.553-010	1.694-012	0.000	0.000	8.674-019
28	11	-4.337-019	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	21	0.000	0.000	0.000	-2.019-028	1.000+000	-5.622-028	0.000	0.000	0.000	0.000
29	1	0.000	0.000	0.000	0.000	0.000	3.931-016	0.000	0.000	0.000	0.000
29	21	0.000	0.000	0.000	1.000+000	0.000	1.732+000	0.000	0.000	0.000	0.000
30	1	0.000	0.000	0.000	0.000	-1.088-002	0.000	1.279-004	0.000	0.000	-8.225-003
30	11	4.749-003	0.000	-1.260-003	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	21	9.358-002	-1.260-003	2.238-013	0.000	1.522-002	0.000	-2.545-031	1.260-003	-2.238-013	1.384-003

END OF WRITE.

RUN NO. IOG 2 DATE 091275 PAGE NO. 77
RUN BY

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SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 085020
THE CPU TIMER = 72 SEC

OUTPUT MATRIX BCOL (1 X 30)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	0.000	0.000	0.000	0.000	1.379-005	0.000	0.000	0.000	0.000	0.000
1	21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.404-005

END OF WRITE.

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 085022
THE CPU TIMER = 74 SEC

	R AR		RART	
NO	REAL PART	IMAGINARY PART	REAL PART	IMAGINARY PART
1	-.32146+003	.00000	-.37146+003	.00000
2	-.27040+002	-.21868+002	-.27040+002	-.21868+002
3	-.27040+002	.21868+002	-.27040+002	.21868+002
4	-.23898+002	.00000	-.23898+002	.00000
5	-.10860+002	-.19266+002	-.10860+002	.19266+002
6	-.10860+002	.19266+002	-.10860+002	-.19266+002
7	-.46640+001	-.83359+001	-.46640+001	-.83359+001
8	-.46640+001	.83359+001	-.46640+001	.83359+001
9	-.46587+001	-.83154+001	-.46587+001	-.83154+001
10	-.46587+001	.83154+001	-.46587+001	.83154+001
11	-.63430+000	-.34782+001	-.63430+000	-.34782+001
12	-.63430+000	.34782+001	-.63430+000	.34782+001
13	-.20270+000	-.19914+001	-.20270+000	-.19914+001
14	-.20270+000	.19914+001	-.20270+000	.19914+001
15	-.10212-001	-.44868+000	-.10212-001	-.44868+000
16	-.10212-001	.44868+000	-.10212-001	.44868+000
17	-.10186-001	-.43904+000	-.10186-001	-.43904+000
18	-.10186-001	.43904+000	-.10186-001	.43904+000
19	-.17694-002	.00000	-.17694-002	.00000
20	.00000	.00000	.00000	.00000
21	.00000	.00000	.00000	.00000
22	.00000	.00000	.00000	.00000
23	.00000	.00000	.00000	.00000
24	.00000	.00000	.00000	.00000
25	.00000	.00000	.00000	.00000
26	.00000	.00000	.00000	.00000
27	.00000	.00000	.00000	.00000
28	.00000	.00000	.00000	.00000
29	.00000	.00000	.00000	.00000
30	.17694-002	.00000	.17694-002	.00000

VI-80

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 085024
THE CPU TIMER = 74 SEC

OUTPUT MATRIX ANUM (30 X 30)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	-6.337-005	0.000	0.000	0.000	0.000	6.337-005	0.000	0.000	0.000	0.000
1	11	0.000	0.000	0.000	-6.244-004	0.000	0.000	0.000	0.000	0.000	0.000
1	21	0.000	0.000	-3.122-004	0.000	0.000	0.000	5.416-022	0.000	3.122-004	0.000
2	1	0.000	-6.504-004	0.000	-2.919-004	0.000	1.094-004	0.000	8.292-006	2.919-004	0.000
2	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.170-005	0.000	2.876-003
3	1	0.000	0.000	-1.400-002	0.000	0.000	0.000	-1.050-002	0.000	0.000	7.000-003
3	11	1.212-002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.379-001	0.000
3	21	0.000	0.000	0.000	0.000	-1.295-002	0.000	0.000	0.000	0.000	0.000
4	1	0.000	-3.080-002	0.000	-1.400-002	0.000	5.250-003	0.000	0.000	1.400-002	0.000
4	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.379-001
5	1	0.000	0.000	0.000	0.000	-1.264-002	0.000	-4.006-005	0.000	0.000	-9.547-003
5	11	5.512-003	0.000	3.947-004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	21	1.086-001	3.947-004	-7.011-014	0.000	1.766-002	0.000	7.971-032	-3.947-004	7.011-014	0.000
6	1	9.072-001	2.067+001	0.000	9.397+000	0.000	-4.431+000	0.000	0.000	-9.397+000	0.000
6	11	0.000	-2.888-007	0.000	8.939+000	0.000	0.000	0.000	-2.888-007	0.000	-9.259+001
6	21	0.000	0.000	4.470+000	2.454+003	0.000	8.410+003	4.621+004	0.000	5.451+004	0.000
7	1	0.000	0.000	-9.644+000	0.000	-5.628-001	0.000	-8.090+000	0.000	0.000	4.440+000
7	11	8.572+000	0.000	8.447+000	0.000	0.000	0.000	0.000	0.000	9.502+001	0.000
7	21	4.345+000	8.436+000	-1.501-009	0.000	1.151+003	0.000	2.737-024	2.575+004	1.501-009	0.000
8	1	0.000	1.269+000	0.000	0.000	0.000	0.000	0.000	-1.269+000	0.000	0.000
8	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-1.250+001	0.000	0.000
8	21	0.000	0.000	2.274-013	0.000	0.000	3.358+003	3.731+004	0.000	-2.274-013	0.000
9	1	2.471-001	8.765+000	0.000	3.984+000	0.000	-1.741+000	0.000	0.000	-3.984+000	0.000
9	11	0.000	-7.866-008	0.000	2.435+000	0.000	0.000	0.000	-7.866-008	0.000	-3.925+001
9	21	0.000	0.000	1.217+000	6.185+002	0.000	2.204+003	1.259+004	0.000	1.374+004	0.000
10	1	0.000	0.000	4.726-002	0.000	-3.138-001	0.000	2.588-002	0.000	0.000	-2.602-001
10	11	9.564-002	0.000	9.425-002	0.000	0.000	0.000	0.000	0.000	-4.456-001	0.000
10	21	2.691+000	9.540-002	-1.674-011	0.000	9.333+000	0.000	2.090-026	1.966+002	1.674-011	0.000
11	1	0.000	0.000	1.042-001	0.000	2.121-001	0.000	5.704-002	0.000	0.000	1.092-001
11	11	-1.833-001	0.000	2.077-001	0.000	0.000	0.000	0.000	0.000	-1.026+000	0.000
11	21	-1.835+000	2.123-001	-3.690-011	0.000	2.831+001	0.000	6.732-026	6.333+002	3.690-011	0.000
12	1	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

RUN NO. IOG 2

DATE 091275

RUN BY

CURRENT TIME = 085024

THE CPU TIMER = 74 SEC

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)

SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

OUTPUT MATRIX ANUM (30 X 30) CONTINUED

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
13	1	0.000	0.000	0.000	0.000	-6.667-002	0.000	0.000	0.000	0.000	0.000
14	1	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	1	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	1	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000	0.000
17	1	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000	0.000	0.000	0.000
18	1	0.000	-1.000+000	0.000	0.000	0.000	0.000	0.000	1.000+000	0.000	0.000
19	1	0.000	0.000	-1.000+000	0.000	0.000	0.000	-7.500-001	0.000	0.000	5.000-001
19	11	8.660-001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	21	0.000	0.000	0.000	0.000	-9.250-001	0.000	0.000	0.000	0.000	0.000
20	1	0.000	-2.200+000	0.000	-1.000+000	0.000	3.750-001	0.000	0.000	1.000+000	0.000
21	1	0.000	0.000	0.000	0.000	-1.147+000	0.000	0.000	0.000	0.000	-8.660-001
21	11	5.000-001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	21	0.000	0.000	0.000	0.000	1.662+000	0.000	0.000	0.000	0.000	0.000
22	1	0.000	0.000	0.000	0.000	0.000	-4.039-028	-1.000+000	0.000	0.000	8.674-019
22	11	-4.337-019	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	21	0.000	0.000	0.000	3.503-046	1.000+000	9.571-046	0.000	0.000	0.000	0.000
23	1	0.000	0.000	0.000	0.000	0.000	-2.000+000	0.000	0.000	0.000	0.000
23	21	0.000	0.000	0.000	1.000+000	0.000	1.732+000	0.000	0.000	0.000	0.000
24	1	-3.939-002	4.281-001	0.000	1.946-001	0.000	-3.358-002	0.000	0.000	-1.946-001	0.000
24	11	0.000	1.602-008	0.000	-3.881-001	0.000	0.000	0.000	1.602-008	0.000	-1.917+000
24	21	0.000	0.000	-1.941-001	-1.357+002	0.000	-4.156+002	-2.006+003	0.000	-3.014+003	0.000
25	1	0.000	0.000	-9.194-002	0.000	6.106-001	0.000	-5.035-002	0.000	0.000	5.062-001
25	11	-1.861-001	0.000	-1.834-001	0.000	0.000	0.000	0.000	0.000	9.059-001	0.000
25	21	-5.236+000	-2.014-001	3.258-011	0.000	-5.526+001	0.000	-1.282-025	-1.207+003	-3.258-011	0.000
26	1	0.000	0.000	0.000	0.000	0.000	-1.388-017	0.000	0.000	0.000	0.000
26	21	0.000	0.000	-7.981-009	-5.748+001	0.000	-2.323+002	-1.475+003	0.000	-1.277+003	0.000
27	1	0.000	0.000	0.000	0.000	0.000	3.903-016	0.000	0.000	0.000	0.000
27	21	0.000	0.000	0.000	0.000	0.000	2.000+000	0.000	0.000	0.000	0.000
28	1	0.000	0.000	0.000	0.000	0.000	3.553-010	1.694-012	0.000	0.000	8.674-019

ORIGINAL PAGE IS OF POOR QUALITY

VI-82

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 085024
THE CPU TIMER = 74 SEC

OUTPUT MATRIX ANUM (30 X 30) CONTINUED

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
28	11	-4.337-019	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	21	0.000	0.000	0.000	-2.019-028	1.000+000	-5.622-028	0.000	0.000	0.000	0.000
29	1	0.000	0.000	0.000	0.000	0.000	3.931-016	0.000	0.000	0.000	0.000
29	21	0.000	0.000	0.000	1.000+000	0.000	1.732+000	0.000	0.000	0.000	0.000
30	1	0.000	0.000	0.000	0.000	2.471+002	0.000	-2.904+000	0.000	0.000	1.868+002
30	11	-1.078+002	0.000	2.862+001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	21	-2.125+003	2.862+001	-5.083-009	0.000	-3.455+002	0.000	5.779-027	-2.862+001	5.083-009	1.000+000

END OF WRITE.

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 085025
THE CPU TIMER = 75 SEC

	NUM		DEN	
NO	REAL PART	IMAGINARY PART	REAL PART	IMAGINARY PART
1	-.32146+003	.00000	-.32146+003	.00000
2	-.27040+002	-.21868+002	-.27040+002	-.21863+002
3	-.27040+002	.21868+002	-.27040+002	.21868+002
4	-.23898+002	.00000	-.23898+002	.00000
5	-.10860+002	-.19266+002	-.10860+002	-.19266+002
6	-.10860+002	.19266+002	-.10860+002	.19266+002
7	-.46640+001	-.83359+001	-.46640+001	-.83359+001
8	-.46640+001	.83359+001	-.46640+001	.83359+001
9	-.46587+001	-.83154+001	-.46587+001	-.83154+001
10	-.46587+001	.83154+001	-.46587+001	.83154+001
11	-.63430+000	-.34782+001	-.63430+000	-.34782+001
12	-.63430+000	.34782+001	-.63430+000	.34782+001
13	-.20170+000	.19865+001	-.20270+000	-.19914+001
14	-.20170+000	-.19865+001	-.20270+000	.19914+001
15	-.10212-001	-.44868+000	-.10212-001	-.44868+000
16	-.10212-001	.44868+000	-.10212-001	.44868+000
17	-.10200-001	-.43935+000	-.10186-001	-.43904+000
18	-.10200-001	.43935+000	-.10186-001	.43904+000
19	.00000	.00000	-.17694-002	.00000
20	.00000	.00000	.00000	.00000
21	.00000	.00000	.00000	.00000
22	.00000	.00000	.00000	.00000
23	.00000	.00000	.00000	.00000
24	.00000	.00000	.00000	.00000
25	.00000	.00000	.00000	.00000
26	.00000	.00000	.00000	.00000
27	.00000	.72784-003	.00000	.00000
28	.00000	-.72784-003	.00000	.00000
29	.00000	.00000	.00000	.00000
30			.17694-002	.00000

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 085025
THE CPU TIMER = 75 SEC

OUTPUT MATRIX RRED (1 X 107)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	1	0.000	9.000+000	0.000	2.000+000	8.000+000	1.000+000	-7.425-006	7.775-001	3.478+001	4.911-001
1	11	2.212+001	4.883-001	9.552+000	4.888-001	9.531+000	1.794-001	3.536+000	1.010-001	1.997+000	2.275-002
1	21	4.488-001	2.321-002	4.395-001	0.000	7.278-004	5.652+002	-5.652+002	7.775-001	3.478+001	4.911-001
1	31	2.212+001	4.883-001	9.552+000	4.888-001	9.531+000	1.794-001	3.536+000	1.013-001	2.002+000	2.275-002
1	41	4.498-001	2.320-002	4.392-001	0.000	0.000	0.000	0.000	0.000	0.000	0.000

END OF WRITE.

RUN NO. IOG 2 DATE 091275 PAGE NO. 84
RUN BY

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN) CURRENT TIME = 085025
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT THE CPU TIMER = 75 SEC

SENSOR Z- VELOCITY / CREW MOTION FORCE

FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG
.100000-001	.159155-002	.561495-008	-.423212-002	.423212-002	-47.469	4.7124	270.0000
.110000-001	.175070-002	.463177-008	-.387134-002	.387134-002	-48.243	4.7124	270.0000
.125000-001	.198944-002	.355613-008	-.342967-002	.342967-002	-49.295	4.7124	270.0000
.140000-001	.222817-002	.280623-008	-.307658-002	.307658-002	-50.239	4.7124	270.0000
.160000-001	.254648-002	.208936-008	-.270368-002	.270368-002	-51.361	4.7124	270.0000
.180000-001	.286479-002	.159167-008	-.241043-002	.241043-002	-52.358	4.7124	270.0000
.200000-001	.318310-002	.122860-008	-.217401-002	.217401-002	-53.255	4.7124	270.0000
.220000-001	.350141-002	.960927-009	-.197950-002	.197950-002	-54.069	4.7124	270.0000
.250000-001	.397887-002	.668441-009	-.174492-002	.174492-002	-55.164	4.7124	270.0000
.280000-001	.445634-002	.459531-009	-.155981-002	.155981-002	-56.139	4.7124	270.0000
.320000-001	.509296-002	.267362-009	-.136633-002	.136633-002	-57.289	4.7124	270.0000
.380000-001	.604789-002	.753823-010	-.115179-002	.115179-002	-58.773	4.7124	270.0000
.450000-001	.716197-002	-.671151-010	-.973332-003	.973332-003	-60.235	4.7124	270.0000
.520000-001	.827606-002	-.166227-009	-.842692-003	.842692-003	-61.487	4.7124	270.0000
.620000-001	.986761-002	-.271829-009	-.707062-003	.707062-003	-63.011	4.7124	269.9999
.700000-001	.111408-001	-.341714-009	-.626388-003	.626388-003	-64.063	4.7124	269.9999
.780000-001	.124141-001	-.406773-009	-.562229-003	.562229-003	-65.002	4.7124	269.9999
.890000-001	.141648-001	-.493747-009	-.492814-003	.492814-003	-66.146	4.7124	269.9999
.100000+000	.159155-001	-.586743-009	-.438653-003	.438653-003	-67.158	4.7124	269.9999
.110000+000	.175070-001	-.678345-009	-.398806-003	.398806-003	-67.985	4.7124	269.9999
.125000+000	.198944-001	-.833715-009	-.350982-003	.350982-003	-69.094	4.7124	269.9998
.140000+000	.222817-001	-.101976-008	-.313401-003	.313401-003	-70.078	4.7124	269.9998
.160000+000	.254648-001	-.132994-008	-.274251-003	.274251-003	-71.237	4.7124	269.9997
.180000+000	.286479-001	-.173626-008	-.243800-003	.243800-003	-72.259	4.7124	269.9996
.200000+000	.318310-001	-.227501-008	-.219441-003	.219441-003	-73.174	4.7124	269.9994
.220000+000	.350141-001	-.300178-008	-.199513-003	.199513-003	-74.001	4.7124	269.9991
.250000+000	.397887-001	-.464253-008	-.175606-003	.175606-003	-75.109	4.7124	269.9985
.263354+000	.419141-001	-.569962-008	-.166720-003	.166720-003	-75.560	4.7124	269.9980
.307246+000	.488998-001	-.120510-007	-.142978-003	.142978-003	-76.895	4.7123	269.9951
.329193+000	.523926-001	-.187184-007	-.133503-003	.133503-003	-77.490	4.7122	269.9919
.351139+000	.558855-001	-.312878-007	-.125240-003	.125240-003	-78.045	4.7121	269.9857
.368696+000	.586798-001	-.511758-007	-.119372-003	.119372-003	-78.462	4.7120	269.9754
.386253+000	.614740-001	-.940387-007	-.114095-003	.114095-003	-78.855	4.7116	269.9527
.395031+000	.628712-001	-.136371-006	-.111672-003	.111672-003	-79.041	4.7112	269.9300
.403810+000	.642683-001	-.211620-006	-.109399-003	.109399-003	-79.220	4.7105	269.8891
.412588+000	.656654-001	-.361955-006	-.107294-003	.107294-003	-79.388	4.7090	269.8067
.421367+000	.670626-001	-.713398-006	-.105375-003	.105377-003	-79.545	4.7056	269.6121
.423561+000	.674119-001	-.868878-006	-.104918-003	.104921-003	-79.583	4.7041	269.5255
.425756+000	.677611-001	-.106984-005	-.104458-003	.104464-003	-79.621	4.7021	269.4132
.427950+000	.681104-001	-.132866-005	-.103981-003	.103989-003	-79.660	4.6996	269.2679

RUN BY

CURRENT TIME = 085025
THE CPU TIMER = 76 SEC

VI-86

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

SENSOR Z- VELOCITY / CREW MOTION FORCE

	FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG	
	.430145+000	.684597-001	-.165520-005	-.103456-003	.103470-003	-79.704	4.6964	269.0834	
	.431991+000	.687391-001	-.196378-005	-.102973-003	.102991-003	-79.744	4.6933	268.9074	
	.433656+000	.690186-001	-.229766-005	-.102399-003	.102425-003	-79.792	4.6900	268.7146	
	.434534+000	.691583-001	-.246304-005	-.102070-003	.102099-003	-79.820	4.6883	268.6176	
	.435412+000	.692980-001	-.261833-005	-.101709-003	.101743-003	-79.850	4.6866	268.5253	
	.436290+000	.694377-001	-.275512-005	-.101317-003	.101355-003	-79.883	4.6852	268.4423	
	.437168+000	.695774-001	-.286463-005	-.100898-003	.100939-003	-79.919	4.6840	268.3737	
	.438046+000	.697171-001	-.293884-005	-.100457-003	.100500-003	-79.957	4.6831	268.3243	
	.438397+000	.697730-001	-.295723-005	-.100277-003	.100320-003	-79.972	4.6829	268.3108	
	.438704+000	.698219-001	-.296770-005	-.100118-003	.100162-003	-79.986	4.6828	268.3021	
	.438814+000	.698394-001	-.297014-005	-.100061-003	.100105-003	-79.991	4.6827	268.2997	
	.438880+000	.698499-001	-.297128-005	-.100027-003	.100071-003	-79.994	4.6827	268.2985	
	.438888+000	.698513-001	-.297141-005	-.100022-003	.100066-003	-79.994	4.6827	268.2984	
	.438897+000	.698527-001	-.297154-005	-.100017-003	.100062-003	-79.995	4.6827	268.2982	
	.438906+000	.698541-001	-.297166-005	-.100013-003	.100057-003	-79.995	4.6827	268.2981	
	.438915+000	.698555-001	-.297178-005	-.100008-003	.100052-003	-79.995	4.6827	268.2979	
	.438919+000	.698562-001	-.297184-005	-.100006-003	.100050-003	-79.996	4.6827	268.2978	
••••••••	.438924+000	.698569-001	-.297189-005	-.100004-003	.100048-003	-79.996	4.6827	268.2978	••••••••
	.439007+000	.698702-001	-.297277-005	-.999603-004	.100005-003	-80.000	4.6827	268.2965	
	.439117+000	.698876-001	-.297331-005	-.999033-004	.999475-004	-80.005	4.6826	268.2952	
	.439183+000	.698981-001	-.297330-005	-.998690-004	.999133-004	-80.008	4.6826	268.2947	
	.439192+000	.698995-001	-.297328-005	-.998645-004	.999087-004	-80.008	4.6826	268.2946	
	.439200+000	.699009-001	-.297326-005	-.998599-004	.999042-004	-80.008	4.6826	268.2945	
	.439209+000	.699023-001	-.297323-005	-.998553-004	.998996-004	-80.009	4.6826	268.2945	
	.439218+000	.699037-001	-.297320-005	-.998508-004	.998950-004	-80.009	4.6826	268.2944	
	.439222+000	.699044-001	-.297318-005	-.998485-004	.998927-004	-80.009	4.6826	268.2944	
••••••••	.439227+000	.699051-001	-.297316-005	-.998462-004	.998905-004	-80.010	4.6826	268.2944	••••••••
	.439231+000	.699058-001	-.297314-005	-.998439-004	.998882-004	-80.010	4.6826	268.2943	
	.439236+000	.699065-001	-.297311-005	-.998416-004	.998859-004	-80.010	4.6826	268.2943	
	.439244+000	.699079-001	-.297307-005	-.998371-004	.998813-004	-80.010	4.6826	268.2942	
	.439253+000	.699093-001	-.297302-005	-.998325-004	.998768-004	-80.011	4.6826	268.2942	
	.439262+000	.699107-001	-.297296-005	-.998280-004	.998722-004	-80.011	4.6826	268.2942	
	.439271+000	.699121-001	-.297290-005	-.998234-004	.998677-004	-80.012	4.6826	268.2941	
	.439337+000	.699226-001	-.297231-005	-.997892-004	.998334-004	-80.014	4.6826	268.2939	
	.439446+000	.699401-001	-.297078-005	-.997322-004	.997764-004	-80.019	4.6826	268.2938	
	.439754+000	.699891-001	-.296284-005	-.995729-004	.996170-004	-80.033	4.6826	268.2956	
	.440107+000	.700452-001	-.294725-005	-.993921-004	.994358-004	-80.049	4.6827	268.3015	
	.440991+000	.701859-001	-.287940-005	-.989494-004	.989913-004	-80.088	4.6833	268.3331	
	.441878+000	.703271-001	-.277501-005	-.985277-004	.985668-004	-80.125	4.6842	268.3867	
	.442769+000	.704689-001	-.264179-005	-.981338-004	.981694-004	-80.160	4.6855	268.4579	
	.443663+000	.706112-001	-.248854-005	-.977714-004	.978031-004	-80.193	4.6869	268.5420	
	.444561+000	.707542-001	-.232380-005	-.974413-004	.974690-004	-80.223	4.6885	268.6338	

CURRENT TIME = 085027
THE CPU TIMER = 76 SEC

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

SENSOR Z- VELOCITY / CREW MOTION FORCE

	FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG	
	.446369+000	.710418-001	-.198815-005	-.968706-004	.968910-004	-80.274	4.6919	268.8242	
	.448191+000	.713317-001	-.167568-005	-.963957-004	.964103-004	-80.318	4.6950	269.0041	
	.448450+000,	.713731-001	-.163447-005	-.963343-004	.963482-004	-80.323	4.6954	269.0279	
	.448518+000	.713838-001	-.162395-005	-.963186-004	.963323-004	-80.325	4.6955	269.0340	
	.448527+000	.713852-001	-.162255-005	-.963165-004	.963302-004	-80.325	4.6955	269.0349	
	.448536+000	.713867-001	-.162116-005	-.963144-004	.963281-004	-80.325	4.6956	269.0357	
	.448545+000	.713881-001	-.161976-005	-.963123-004	.963259-004	-80.325	4.6956	269.0365	
	.448554+000	.713895-001	-.161837-005	-.963103-004	.963238-004	-80.325	4.6956	269.0373	
	.448558+000	.713902-001	-.161767-005	-.963092-004	.963228-004	-80.325	4.6956	269.0377	
	.448563+000	.713910-001	-.161697-005	-.963082-004	.963217-004	-80.326	4.6956	269.0381	********
********	.448563+000	.713910-001	-.161697-005	-.963082-004	.963217-004	-80.326	4.6956	269.0381	********
********	.448567+000	.713917-001	-.161628-005	-.963071-004	.963207-004	-80.326	4.6956	269.0385	
	.448572+000	.713924-001	-.161558-005	-.963061-004	.963196-004	-80.326	4.6956	269.0389	
	.448581+000	.713938-001	-.161419-005	-.963040-004	.963175-004	-80.326	4.6956	269.0397	
	.448589+000	.713952-001	-.161280-005	-.963019-004	.963154-004	-80.326	4.6956	269.0405	
	.448598+000	.713967-001	-.161141-005	-.962999-004	.963133-004	-80.326	4.6957	269.0413	
	.448607+000	.713981-001	-.161002-005	-.962978-004	.963112-004	-80.326	4.6957	269.0421	
	.448675+000	.714088-001	-.159964-005	-.962823-004	.962956-004	-80.328	4.6958	269.0481	
	.448787+000	.714267-001	-.158248-005	-.962566-004	.962696-004	-80.330	4.6959	269.0581	
	.449101+000	.714767-001	-.153530-005	-.961858-004	.961981-004	-80.337	4.6964	269.0855	
	.449461+000	.715340-001	-.148301-005	-.961067-004	.961182-004	-80.344	4.6970	269.1159	
	.450364+000	.716777-001	-.135987-005	-.959164-004	.959260-004	-80.361	4.6982	269.1877	
	.451270+000	.718219-001	-.124742-005	-.957346-004	.957427-004	-80.378	4.6994	269.2534	
	.452180+000	.719667-001	-.114519-005	-.955592-004	.955661-004	-80.394	4.7004	269.3134	
	.453094+000	.721121-001	-.105254-005	-.953886-004	.953944-004	-80.410	4.7014	269.3678	
	.454011+000	.722580-001	-.968716-006	-.952212-004	.952261-004	-80.425	4.7022	269.4171	
	.455855+000	.725518-001	-.824454-006	-.948922-004	.948957-004	-80.455	4.7037	269.5022	
	.457717+000	.728479-001	-.706500-006	-.945662-004	.945688-004	-80.485	4.7049	269.5719	
	.460064+000	.732215-001	-.588290-006	-.941578-004	.941597-004	-80.523	4.7061	269.6420	
	.462436+000	.735989-001	-.495133-006	-.937453-004	.937466-004	-80.561	4.7071	269.6974	
	.464832+000	.739803-001	-.420947-006	-.933271-004	.933280-004	-80.600	4.7079	269.7415	
	.467253+000	.743656-001	-.361218-006	-.929029-004	.929036-004	-80.639	4.7085	269.7772	
	.477194+000	.759478-001	-.211645-006	-.911521-004	.911523-004	-80.805	4.7101	269.8669	
	.487568+000	.775989-001	-.136200-006	-.893372-004	.893373-004	-80.979	4.7109	269.9126	
	.498403+000	.793233-001	-.935408-007	-.874820-004	.874820-004	-81.162	4.7113	269.9387	
	.509733+000	.811261-001	-.673043-007	-.856007-004	.856007-004	-81.350	4.7116	269.9549	
	.534003+000	.849892-001	-.382706-007	-.817911-004	.817911-004	-81.746	4.7119	269.9732	
	.560703+000	.892387-001	-.235046-007	-.779453-004	.779453-004	-82.164	4.7121	269.9827	
	.598083+000	.951879-001	-.134176-007	-.731104-004	.731104-004	-82.720	4.7122	269.9895	
	.640804+000	.101987+000	-.757069-008	-.682574-004	.682574-004	-83.317	4.7123	269.9936	
	.700000+000	.111408+000	-.314524-008	-.624978-004	.624978-004	-84.083	4.7123	269.9971	

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SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 085027
THE CPU TIMER = 77 SEC

SENSOR Z- VELOCITY / CREW MOTION FORCE

FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG
.780000+000	.124141+000	.421718-009	-.560912-004	.560912-004	-85.022	4.7124	270.0004
.890000+000	.141648+000	.406789-008	-.491522-004	.491522-004	-86.169	4.7125	270.0047
.100000+001	.159155+000	.777294-008	-.437324-004	.437324-004	-87.184	4.7126	270.0102
.110000+001	.175070+000	.119312-007	-.397406-004	.397406-004	-88.015	4.7127	270.0172
.118573+001	.188715+000	.166060-007	-.368503-004	.368503-004	-88.671	4.7128	270.0258
.138335+001	.220168+000	.351897-007	-.315361-004	.315361-004	-90.024	4.7135	270.0639
.148216+001	.235894+000	.526338-007	-.293991-004	.293992-004	-90.633	4.7142	270.1025
.158098+001	.251620+000	.816245-007	-.275194-004	.275195-004	-91.207	4.7154	270.1699
.166002+001	.264201+000	.119938-006	-.261694-004	.261697-004	-91.644	4.7170	270.2626
.173907+001	.276782+000	.191984-006	-.249397-004	.249403-004	-92.062	4.7197	270.4180
.177860+001	.283073+000	.226189-006	-.243691-004	.243701-004	-92.263	4.7217	270.5318
.181812+001	.289363+000	.281279-006	-.238307-004	.238324-004	-92.457	4.7242	270.6762
.185765+001	.295654+000	.346949-006	-.233297-004	.233323-004	-92.641	4.7273	270.8520
.189717+001	.301944+000	.418590-006	-.228728-004	.228767-004	-92.812	4.7307	271.0484
.190705+001	.303517+000	.436244-006	-.227663-004	.227704-004	-92.853	4.7315	271.0977
.191693+001	.305089+000	.453326-006	-.226629-004	.226674-004	-92.892	4.7324	271.1459
.192681+001	.306662+000	.469554-006	-.225626-004	.225675-004	-92.930	4.7332	271.1922
.193669+001	.308235+000	.494632-006	-.224655-004	.224707-004	-92.968	4.7340	271.2358
.194460+001	.309493+000	.495666-006	-.223899-004	.223954-004	-92.997	4.7345	271.2682
.195250+001	.310751+000	.505625-006	-.223161-004	.223218-004	-93.025	4.7350	271.2979
.195646+001	.311380+000	.510156-006	-.222799-004	.222857-004	-93.039	4.7353	271.3117
.196041+001	.312009+000	.514366-006	-.222440-004	.222500-004	-93.053	4.7355	271.3246
.196436+001	.312638+000	.518239-006	-.222086-004	.222146-004	-93.067	4.7357	271.3367
.196831+001	.313267+000	.521762-006	-.221735-004	.221796-004	-93.081	4.7359	271.3479
.197227+001	.313896+000	.524921-006	-.221388-004	.221450-004	-93.094	4.7361	271.3582
.197395+001	.314148+000	.526081-006	-.221250-004	.221312-004	-93.100	4.7362	271.3621
.197523+001	.314368+000	.527045-006	-.221130-004	.221192-004	-93.105	4.7362	271.3653
.197572+001	.314446+000	.527378-006	-.221087-004	.221150-004	-93.106	4.7362	271.3664
.197602+001	.314494+000	.527576-006	-.221061-004	.221124-004	-93.107	4.7362	271.3671
.197606+001	.314500+000	.527601-006	-.221058-004	.221121-004	-93.107	4.7362	271.3672
.197610+001	.314506+000	.527627-006	-.221054-004	.221117-004	-93.108	4.7363	271.3673
.197614+001	.314512+000	.527653-006	-.221051-004	.221114-004	-93.108	4.7363	271.3674
.197618+001	.314519+000	.527680-006	-.221047-004	.221110-004	-93.108	4.7363	271.3675
.197620+001	.314522+000	.527693-006	-.221046-004	.221109-004	-93.108	4.7363	271.3675
.... .197622+001	.314525+000	.527705-006	-.221044-004	.221107-004	-93.108	4.7363	271.3675 ....
.197624+001	.314528+000	.527718-006	-.221042-004	.221105-004	-93.108	4.7363	271.3676
.197626+001	.314531+000	.527731-006	-.221041-004	.221104-004	-93.108	4.7363	271.3676
.197630+001	.314538+000	.527757-006	-.221037-004	.221100-004	-93.108	4.7363	271.3677
.197634+001	.314544+000	.527783-006	-.221034-004	.221097-004	-93.108	4.7363	271.3678
.197638+001	.314550+000	.527809-006	-.221030-004	.221093-004	-93.108	4.7363	271.3679
.197642+001	.314556+000	.527835-006	-.221027-004	.221090-004	-93.109	4.7363	271.3680

RUN NO. IOG 2 DATE 091275 PAGE NO. 88

RUN BY

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 085028
THE CPU TIMER = 77 SEC

SENSOR Z- VELOCITY / CREW MOTION FORCE

	FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG	
	.197671+001	.314604+000	.528027-006	-.221001-004	.221064-004	-93.110	4.7363	271.3686	
	.197721+001	.314682+000	.528342-006	-.220958-004	.221022-004	-93.111	4.7363	271.3697	
	.197859+001	.314903+000	.529194-006	-.220839-004	.220902-004	-93.116	4.7363	271.3727	
	.198018+001	.315155+000	.530109-006	-.220702-004	.220766-004	-93.121	4.7364	271.3759	
	.198100+001	.315285+000	.530555-006	-.220632-004	.220696-004	-93.124	4.7364	271.3775	
....	.198101+001	.315288+000	.530566-006	-.220631-004	.220695-004	-93.124	4.7364	271.3775	....
	.198103+001	.315291+000	.530576-006	-.220629-004	.220693-004	-93.124	4.7364	271.3776	
	.198105+001	.315295+000	.530587-006	-.220627-004	.220691-004	-93.124	4.7364	271.3776	
	.198109+001	.315301+000	.530608-006	-.220624-004	.220688-004	-93.124	4.7364	271.3777	
	.198113+001	.315307+000	.530629-006	-.220621-004	.220684-004	-93.125	4.7364	271.3778	
	.198117+001	.315314+000	.530650-006	-.220617-004	.220681-004	-93.125	4.7364	271.3778	
	.198121+001	.315320+000	.530671-006	-.220614-004	.220678-004	-93.125	4.7364	271.3779	
	.198151+001	.315367+000	.530828-006	-.220588-004	.220652-004	-93.126	4.7364	271.3785	
	.198201+001	.315446+000	.531084-006	-.220546-004	.220610-004	-93.128	4.7365	271.3794	
	.198340+001	.315667+000	.531770-006	-.220427-004	.220491-004	-93.132	4.7365	271.3819	
	.198498+001	.315920+000	.532493-006	-.220292-004	.220356-004	-93.137	4.7366	271.3847	
	.198897+001	.316555+000	.534022-006	-.219954-004	.220019-004	-93.151	4.7367	271.3908	
	.199297+001	.317191+000	.535141-006	-.219617-004	.219683-004	-93.164	4.7367	271.3958	
	.199699+001	.317831+000	.535842-006	-.219282-004	.219347-004	-93.177	4.7368	271.3998	
	.200103+001	.318473+000	.536122-006	-.218946-004	.219012-004	-93.191	4.7369	271.4027	
	.200538+001	.319118+000	.535974-006	-.218611-004	.218677-004	-93.204	4.7369	271.4044	
	.201323+001	.320415+000	.534393-006	-.217940-004	.218006-004	-93.231	4.7369	271.4046	
	.202144+001	.321723+000	.531110-006	-.217268-004	.217333-004	-93.258	4.7368	271.4003	
	.203191+001	.323373+000	.524678-006	-.216421-004	.216484-004	-93.291	4.7366	271.3887	
	.204228+001	.325040+000	.515901-006	-.215564-004	.215626-004	-93.326	4.7363	271.3707	
	.205287+001	.326724+000	.504691-006	-.214694-004	.214753-004	-93.361	4.7359	271.3466	
	.206356+001	.328425+000	.491613-006	-.213808-004	.213865-004	-93.397	4.7354	271.3171	
	.210746+001	.335413+000	.425785-006	-.210074-004	.210117-004	-93.551	4.7327	271.1611	
	.215328+001	.342705+000	.352430-006	-.206028-004	.206058-004	-93.720	4.7295	270.9800	
	.220113+001	.350320+000	.284652-006	-.201736-004	.201756-004	-93.903	4.7265	270.8084	
	.225115+001	.358282+000	.227825-006	-.197288-004	.197301-004	-94.097	4.7239	270.6616	
	.235835+001	.375343+000	.146887-006	-.188183-004	.188189-004	-94.508	4.7202	270.4472	
	.247627+001	.394110+000	.976361-007	-.179015-004	.179018-004	-94.942	4.7178	270.3125	
	.264135+001	.420384+000	.615169-007	-.167597-004	.167598-004	-95.515	4.7161	270.2103	
	.283002+001	.450412+000	.405700-007	-.156248-004	.156249-004	-96.124	4.7150	270.1487	
	.287266+001	.457198+000	.373827-007	-.153898-004	.153898-004	-96.255	4.7148	270.1391	
	.300946+001	.478970+000	.294400-007	-.146821-004	.146821-004	-96.664	4.7144	270.1149	
	.307795+001	.489855+000	.264300-007	-.143525-004	.143525-004	-96.861	4.7142	270.1055	
	.314625+001	.500741+000	.238838-007	-.140376-004	.140376-004	-97.054	4.7141	270.0975	
	.321465+001	.511627+000	.217084-007	-.137364-004	.137364-004	-97.243	4.7140	270.0905	
	.328304+001	.522512+000	.198352-007	-.134479-004	.134479-004	-97.427	4.7139	270.0845	

ORIGINAL PAGE IS OF POOR QUALITY

RUN NO. IOG 2

DATE 091275

RUN BY

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SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 085028
THE CPU TIMER = 78 SEC

SENSOR Z- VELOCITY / CREW MOTION FORCE

	FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG	
	.330014+001	.525234+000	.194070-007	-.133777-004	.133777-004	-97.472	4.7138	270.0831	
	.331724+001	.527955+000	.189938-007	-.133083-004	.133083-004	-97.518	4.7138	270.0817	
	.333434+001	.530677+000	.185945-007	-.132395-004	.132395-004	-97.563	4.7138	270.0804	
	.335144+001	.533398+000	.182087-007	-.131715-004	.131715-004	-97.607	4.7138	270.0792	
	.336512+001	.535575+000	.179089-007	-.131176-004	.131176-004	-97.643	4.7138	270.0782	
	.337890+001	.537752+000	.176172-007	-.130641-004	.130641-004	-97.678	4.7137	270.0772	
	.338564+001	.538841+000	.174739-007	-.130375-004	.130375-004	-97.696	4.7137	270.0768	
	.339248+001	.539929+000	.173328-007	-.130111-004	.130111-004	-97.714	4.7137	270.0763	
	.339932+001	.541018+000	.171936-007	-.129847-004	.129847-004	-97.731	4.7137	270.0758	
	.340616+001	.542107+000	.170559-007	-.129584-004	.129585-004	-97.749	4.7137	270.0754	
	.341300+001	.543195+000	.169202-007	-.129323-004	.129323-004	-97.766	4.7137	270.0749	
	.341573+001	.543631+000	.168666-007	-.129219-004	.129219-004	-97.773	4.7137	270.0748	
	.341813+001	.544012+000	.168196-007	-.129128-004	.129128-004	-97.780	4.7137	270.0746	
	.341898+001	.544148+000	.168029-007	-.129095-004	.129095-004	-97.782	4.7137	270.0745	
	.341949+001	.544229+000	.167927-007	-.129076-004	.129076-004	-97.783	4.7137	270.0745	
	.341956+001	.544240+000	.167916-007	-.129073-004	.129073-004	-97.783	4.7137	270.0745	
	.341963+001	.544251+000	.167902-007	-.129071-004	.129071-004	-97.783	4.7137	270.0745	
	.341970+001	.544262+000	.167889-007	-.129068-004	.129068-004	-97.784	4.7137	270.0745	
	.341977+001	.544273+000	.167875-007	-.129065-004	.129065-004	-97.784	4.7137	270.0745	
	.341980+001	.544278+000	.167868-007	-.129064-004	.129064-004	-97.784	4.7137	270.0745	
••••••••	.341984+001	.544284+000	.167864-007	-.129063-004	.129063-004	-97.784	4.7137	270.0745	••••••••
••••••••	.341984+001	.544284+000	.167864-007	-.129063-004	.129063-004	-97.784	4.7137	270.0745	••••••••
	.341987+001	.544289+000	.167856-007	-.129061-004	.129062-004	-97.784	4.7137	270.0745	
	.341990+001	.544295+000	.167846-007	-.129060-004	.129060-004	-97.784	4.7137	270.0745	
	.341997+001	.544306+000	.167834-007	-.129058-004	.129058-004	-97.784	4.7137	270.0745	
	.342004+001	.544316+000	.167822-007	-.129055-004	.129055-004	-97.785	4.7137	270.0745	
	.342011+001	.544327+000	.167808-007	-.129052-004	.129052-004	-97.785	4.7137	270.0745	
	.342018+001	.544338+000	.167795-007	-.129050-004	.129050-004	-97.785	4.7137	270.0745	
	.342069+001	.544420+000	.167696-007	-.129030-004	.129030-004	-97.786	4.7137	270.0744	
	.342155+001	.544556+000	.167529-007	-.128998-004	.128998-004	-97.788	4.7137	270.0744	
	.342394+001	.544938+000	.167064-007	-.128907-004	.128907-004	-97.794	4.7137	270.0742	
	.342669+001	.545375+000	.166535-007	-.128803-004	.128803-004	-97.801	4.7137	270.0740	
	.343357+001	.546470+000	.165223-007	-.128543-004	.128543-004	-97.819	4.7137	270.0736	
	.344048+001	.547569+000	.163918-007	-.128283-004	.128283-004	-97.837	4.7137	270.0732	
	.344742+001	.548673+000	.162626-007	-.128024-004	.128024-004	-97.854	4.7137	270.0727	
	.345438+001	.549782+000	.161347-007	-.127764-004	.127764-004	-97.872	4.7136	270.0723	
	.346137+001	.550894+000	.160078-007	-.127504-004	.127504-004	-97.890	4.7136	270.0719	
	.347544+001	.553134+000	.157570-007	-.126985-004	.126985-004	-97.925	4.7136	270.0711	
	.348963+001	.555392+000	.155107-007	-.126465-004	.126465-004	-97.961	4.7136	270.0702	
	.350752+001	.558240+000	.152389-007	-.125816-004	.125816-004	-98.005	4.7136	270.0692	
	.352563+001	.561117+000	.149134-007	-.125167-004	.125167-004	-98.050	4.7136	270.0682	

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 085028
THE CPU TIMER = 78 SEC

SENSOR Z- VELOCITY / CREW MOTION FORCE

	FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG	
	.354387+001	.564025+000	.146238-007	-.124518-004	.124518-004	-98.095	4.7136	270.0673	
	.356233+001	.566962+000	.143406-007	-.123869-004	.123869-004	-98.141	4.7135	270.0663	
	.363812+001	.579025+000	.132651-007	-.121275-004	.121275-004	-98.325	4.7135	270.0626	
	.371721+001	.591613+000	.122751-007	-.118681-004	.118681-004	-98.512	4.7134	270.0592	
	.379982+001	.604760+000	.113629-007	-.116089-004	.116089-004	-98.704	4.7134	270.0560	
	.388618+001	.618504+000	.105206-007	-.113498-004	.113498-004	-98.900	4.7133	270.0531	
	.407123+001	.647957+000	.902143-008	-.108319-004	.108319-004	-99.306	4.7132	270.0477	
	.427479+001	.680355+000	.773471-008	-.103144-004	.103144-004	-99.731	4.7131	270.0429	
	.455978+001	.725712+000	.637252-008	-.966791-005	.966791-005	-100.293	4.7130	270.0377	
	.488549+001	.777548+000	.523472-008	-.902188-005	.902188-005	-100.894	4.7130	270.0332	
	.516586+001	.822173+000	.449453-008	-.853124-005	.853124-005	-101.380	4.7129	270.0302	
	.551025+001	.876984+000	.379174-008	-.799714-005	.799714-005	-101.941	4.7129	270.0271	
	.578577+001	.920834+000	.334752-008	-.761577-005	.761577-005	-102.366	4.7128	270.0252	
	.606128+001	.964683+000	.298381-008	-.726915-005	.726915-005	-102.770	4.7128	270.0235	
	.619904+001	.986607+000	.282069-008	-.710741-005	.710742-005	-102.966	4.7128	270.0227	
	.633679+001	.100853+001	.267404-008	-.695273-005	.695273-005	-103.157	4.7128	270.0220	
	.647455+001	.103046+001	.253894-008	-.680464-005	.680464-005	-103.344	4.7128	270.0213	
	.661231+001	.105238+001	.241465-008	-.666273-005	.666273-005	-103.527	4.7127	270.0207	
	.664674+001	.105786+001	.238496-008	-.662817-005	.662817-005	-103.572	4.7127	270.0206	
	.668118+001	.106334+001	.235591-008	-.659397-005	.659397-005	-103.617	4.7127	270.0204	
	.671562+001	.106882+001	.232742-008	-.656012-005	.656012-005	-103.662	4.7127	270.0203	
	.675006+001	.107431+001	.229954-008	-.652662-005	.652662-005	-103.706	4.7127	270.0202	
	.677761+001	.107869+001	.227741-008	-.650006-005	.650006-005	-103.742	4.7127	270.0200	
	.680516+001	.108308+001	.225579-008	-.647372-005	.647372-005	-103.777	4.7127	270.0199	
	.681894+001	.108527+001	.224506-008	-.646063-005	.646063-005	-103.795	4.7127	270.0199	
	.683272+001	.108746+001	.223443-008	-.644759-005	.644759-005	-103.812	4.7127	270.0198	
	.684649+001	.108965+001	.222382-008	-.643461-005	.643461-005	-103.830	4.7127	270.0198	
	.686027+001	.109185+001	.221340-008	-.642167-005	.642167-005	-103.847	4.7127	270.0197	
	.687404+001	.109404+001	.220310-008	-.640879-005	.640879-005	-103.864	4.7127	270.0197	
	.687955+001	.109491+001	.219895-008	-.640366-005	.640366-005	-103.871	4.7127	270.0196	
	.688437+001	.109568+001	.219525-008	-.639917-005	.639917-005	-103.878	4.7127	270.0196	
	.688610+001	.109596+001	.219411-008	-.639756-005	.639757-005	-103.880	4.7127	270.0196	
	.688713+001	.109612+001	.219332-008	-.639660-005	.639660-005	-103.881	4.7127	270.0196	
	.688727+001	.109614+001	.219319-008	-.639648-005	.639648-005	-103.881	4.7127	270.0196	
	.688741+001	.109616+001	.219306-008	-.639635-005	.639635-005	-103.881	4.7127	270.0196	
	.688754+001	.109619+001	.219292-008	-.639622-005	.639622-005	-103.882	4.7127	270.0196	
	.688768+001	.109621+001	.219286-008	-.639609-005	.639609-005	-103.882	4.7127	270.0196	
	.688775+001	.109622+001	.219288-008	-.639603-005	.639603-005	-103.882	4.7127	270.0196	
********	.688782+001	.109623+001	.219275-008	-.639596-005	.639596-005	-103.882	4.7127	270.0196	********
********	.688782+001	.109623+001	.219278-008	-.639596-005	.639596-005	-103.882	4.7127	270.0196	********
	.688789+001	.109624+001	.219261-008	-.639590-005	.639590-005	-103.882	4.7127	270.0196	

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 085029
THE CPU TIMER = 78 SEC

SENSOR Z- VELOCITY / CREW MOTION FORCE

	FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG	
	.688796+001	.109625+001	.219277-008	-.639583-005	.639584-005	-103.882	4.7127	270.0196	
	.688810+001	.109627+001	.219255-008	-.639571-005	.639571-005	-103.882	4.7127	270.0196	
	.688823+001	.109630+001	.219247-008	-.639558-005	.639558-005	-103.882	4.7127	270.0196	
	.688837+001	.109632+001	.219241-008	-.639545-005	.639545-005	-103.883	4.7127	270.0196	
	.688851+001	.109634+001	.219227-008	-.639532-005	.639532-005	-103.883	4.7127	270.0196	
	.688954+001	.109650+001	.219149-008	-.639436-005	.639436-005	-103.884	4.7127	270.0196	
	.689127+001	.109678+001	.219019-008	-.639276-005	.639276-005	-103.886	4.7127	270.0196	
	.689607+001	.109755+001	.218655-008	-.638828-005	.638828-005	-103.892	4.7127	270.0196	
	.690162+001	.109843+001	.218257-008	-.638316-005	.638316-005	-103.899	4.7127	270.0196	
	.690883+001	.109958+001	.217723-008	-.637644-005	.637644-005	-103.908	4.7127	270.0195	
********	.690895+001	.109959+001	.217703-008	-.637638-005	.637638-005	-103.909	4.7127	270.0195	********
********	.690895+001	.109959+001	.217703-008	-.637638-005	.637638-005	-103.909	4.7127	270.0195	********
	.690902+001	.109961+001	.217700-008	-.637632-005	.637632-005	-103.909	4.7127	270.0195	
	.690909+001	.109962+001	.217693-008	-.637625-005	.637625-005	-103.909	4.7127	270.0195	
	.690923+001	.109964+001	.217686-008	-.637612-005	.637613-005	-103.909	4.7127	270.0195	
	.690937+001	.109966+001	.217678-008	-.637600-005	.637600-005	-103.909	4.7127	270.0195	
	.690951+001	.109968+001	.217668-008	-.637587-005	.637587-005	-103.909	4.7127	270.0195	
	.690964+001	.109970+001	.217659-008	-.637574-005	.637574-005	-103.909	4.7127	270.0195	
	.691069+001	.109987+001	.217581-008	-.637478-005	.637479-005	-103.911	4.7127	270.0195	
	.691241+001	.110014+001	.217451-008	-.637319-005	.637319-005	-103.913	4.7127	270.0195	
	.691725+001	.110092+001	.217104-008	-.636872-005	.636872-005	-103.919	4.7127	270.0195	
	.692280+001	.110180+001	.216688-008	-.636362-005	.636362-005	-103.926	4.7127	270.0195	
	.693673+001	.110401+001	.215685-008	-.635085-005	.635085-005	-103.943	4.7127	270.0194	
	.695366+001	.110623+001	.214670-008	-.633809-005	.633809-005	-103.961	4.7127	270.0194	
	.696467+001	.110846+001	.213661-008	-.632532-005	.632532-005	-103.978	4.7127	270.0193	
	.697874+001	.111070+001	.212665-008	-.631256-005	.631256-005	-103.996	4.7127	270.0193	
	.699297+001	.111295+001	.211663-008	-.629979-005	.629980-005	-104.013	4.7127	270.0192	
	.702129+001	.111747+001	.209674-008	-.627427-005	.627427-005	-104.049	4.7127	270.0191	
	.704995+001	.112203+001	.207705-008	-.624874-005	.624874-005	-104.084	4.7127	270.0190	
	.708611+001	.112779+001	.205251-008	-.621683-005	.621683-005	-104.129	4.7127	270.0189	
	.712263+001	.113360+001	.202827-008	-.618492-005	.618492-005	-104.173	4.7127	270.0188	
	.715954+001	.113948+001	.200415-008	-.615301-005	.615301-005	-104.218	4.7127	270.0186	
	.719683+001	.114541+001	.198027-008	-.612111-005	.612111-005	-104.263	4.7127	270.0185	
	.734995+001	.116978+001	.188680-008	-.599348-005	.599348-005	-104.446	4.7127	270.0180	
	.750973+001	.119521+001	.179652-008	-.586586-005	.586586-005	-104.633	4.7127	270.0175	
	.767661+001	.122177+001	.170941-008	-.573825-005	.573825-005	-104.824	4.7127	270.0170	
	.785109+001	.124954+001	.162502-008	-.561064-005	.561064-005	-105.020	4.7127	270.0166	
	.822494+001	.130904+001	.146499-008	-.535545-005	.535545-005	-105.424	4.7127	270.0156	
	.863619+001	.137449+001	.131582-008	-.510029-005	.510029-005	-105.848	4.7126	270.0147	
	.921194+001	.146613+001	.114348-008	-.478136-005	.478136-005	-106.409	4.7126	270.0137	
	.986993+001	.157085+001	.985832-009	-.446247-005	.446247-005	-107.008	4.7126	270.0126	

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

CURRENT TIME = 085030
THE CPU TIMER = 79 SEC

SENSOR Z- VELOCITY / CREW MOTION FORCE

	FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG	
	.111392+002	.177286+001	.762305-009	-.395392-005	.395382-005	-108.060	4.7126	270.0110	
	.119348+002	.189949+001	.658968-009	-.369016-005	.369016-005	-108.659	4.7126	270.0102	
	.127305+002	.202612+001	.575366-009	-.345947-005	.345947-005	-109.220	4.7126	270.0095	
	.133670+002	.212743+001	.519490-009	-.329470-005	.329470-005	-109.644	4.7125	270.0090	
	.140035+002	.222873+001	.471350-009	-.314491-005	.314491-005	-110.048	4.7125	270.0086	
	.143218+002	.227939+001	.449816-009	-.307501-005	.307501-005	-110.243	4.7125	270.0083	
	.146401+002	.233004+001	.429504-009	-.300815-005	.300815-005	-110.434	4.7125	270.0082	
	.149583+002	.238069+001	.410797-009	-.294413-005	.294413-005	-110.621	4.7125	270.0080	
	.152766+002	.243135+001	.393241-009	-.288279-005	.288279-005	-110.804	4.7125	270.0078	
	.153562+002	.244401+001	.389018-009	-.286785-005	.286785-005	-110.849	4.7125	270.0077	
	.154357+002	.245667+001	.384939-009	-.285306-005	.285306-005	-110.894	4.7125	270.0077	
	.155153+002	.246934+001	.380743-009	-.283843-005	.283843-005	-110.938	4.7125	270.0077	
	.155949+002	.248200+001	.376759-009	-.282395-005	.282395-005	-110.783	4.7125	270.0076	
	.156585+002	.249213+001	.373558-009	-.281246-005	.281246-005	-111.018	4.7125	270.0076	
	.157222+002	.250225+001	.370413-009	-.280109-005	.280108-005	-111.054	4.7125	270.0075	
	.157540+002	.250733+001	.368921-009	-.279542-005	.279542-005	-111.071	4.7125	270.0075	
	.157858+002	.251239+001	.367377-009	-.278978-005	.278978-005	-111.089	4.7125	270.0075	
	.158176+002	.251746+001	.365817-009	-.278417-005	.278417-005	-111.106	4.7125	270.0075	
	.158495+002	.252252+001	.364342-009	-.277857-005	.277857-005	-111.124	4.7125	270.0075	
	.158813+002	.252759+001	.362826-009	-.277300-005	.277300-005	-111.141	4.7125	270.0075	
	.158940+002	.252961+001	.362189-009	-.277078-005	.277078-005	-111.148	4.7125	270.0075	
	.159052+002	.253139+001	.361682-009	-.276884-005	.276884-005	-111.154	4.7125	270.0075	
	.159091+002	.253202+001	.361424-009	-.276815-005	.276815-005	-111.156	4.7125	270.0074	
	.159115+002	.253240+001	.361337-009	-.276773-005	.276773-005	-111.158	4.7125	270.0074	
	.159119+002	.253245+001	.361381-009	-.276768-005	.276768-005	-111.158	4.7125	270.0074	
	.159122+002	.253250+001	.361375-009	-.276762-005	.276762-005	-111.158	4.7125	270.0074	
	.159125+002	.253255+001	.361332-009	-.276757-005	.276757-005	-111.158	4.7125	270.0074	
	.159128+002	.253260+001	.361318-009	-.276751-005	.276751-005	-111.158	4.7125	270.0074	
	.159130+002	.253263+001	.361319-009	-.276749-005	.276749-005	-111.158	4.7125	270.0074	
********	.159131+002	.253265+001	.361277-009	-.276746-005	.276746-005	-111.158	4.7125	270.0074	********
********	.159131+002	.253265+001	.361277-009	-.276746-005	.276746-005	-111.158	4.7125	270.0074	********
	.159133+002	.253268+001	.361266-009	-.276743-005	.276743-005	-111.158	4.7125	270.0074	
	.159134+002	.253270+001	.361261-009	-.276740-005	.276740-005	-111.159	4.7125	270.0074	
	.159138+002	.253275+001	.361250-009	-.276735-005	.276735-005	-111.159	4.7125	270.0074	
	.159141+002	.253280+001	.361302-009	-.276729-005	.276729-005	-111.159	4.7125	270.0074	
	.159144+002	.253285+001	.361197-009	-.276724-005	.276724-005	-111.159	4.7125	270.0074	
	.159147+002	.253291+001	.361200-009	-.276718-005	.276718-005	-111.159	4.7125	270.0074	
	.159171+002	.253329+001	.361091-009	-.276677-005	.276677-005	-111.161	4.7125	270.0074	
	.159211+002	.253392+001	.360962-009	-.276607-005	.276607-005	-111.163	4.7125	270.0074	
	.159322+002	.253569+001	.360385-009	-.276414-005	.276414-005	-111.169	4.7125	270.0074	
	.159453+002	.253773+001	.359775-009	-.276192-005	.276192-005	-111.176	4.7125	270.0074	

SPACELAB - INSIDE OUT GIMBAL CONCEPT (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT

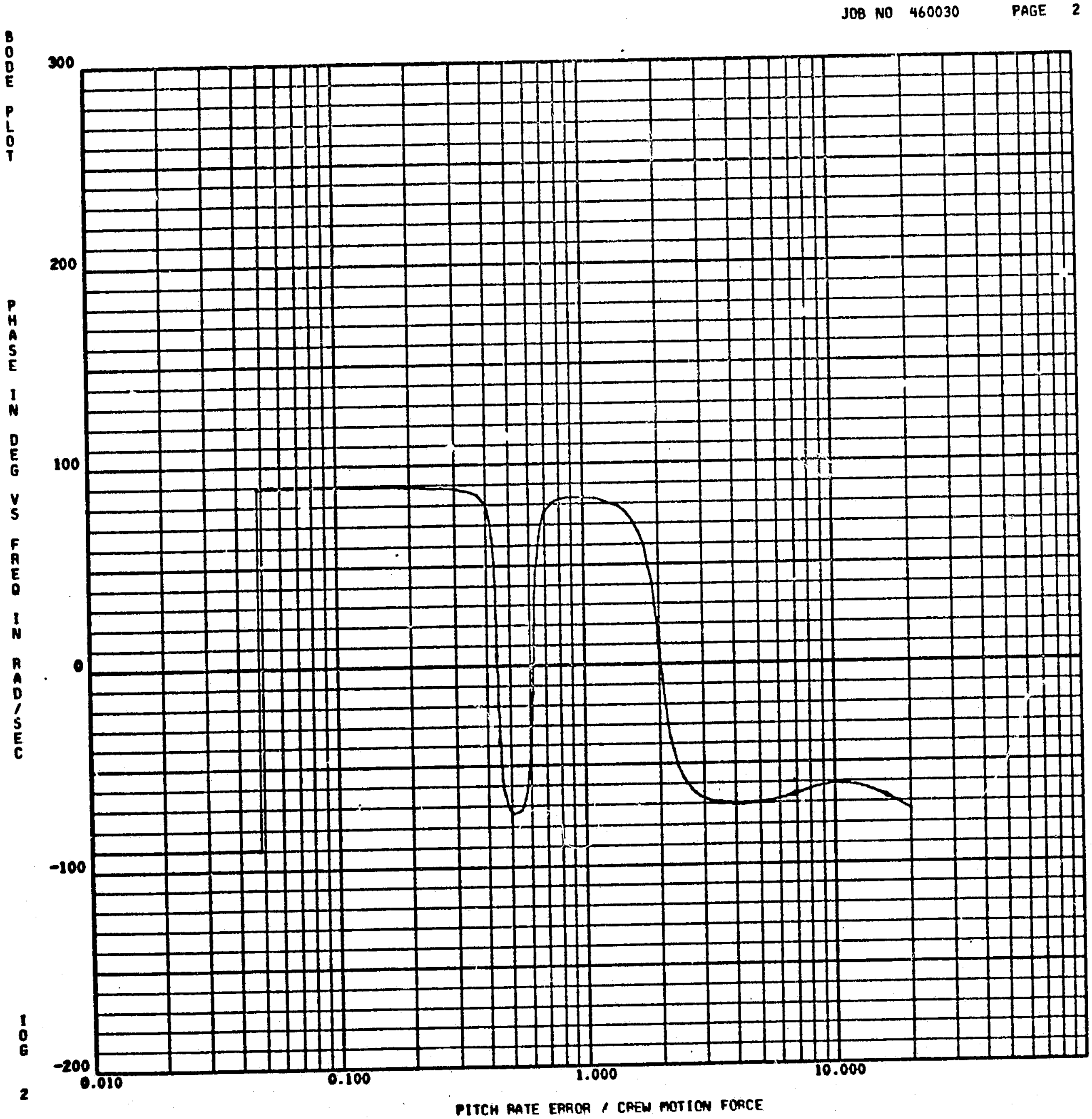
CURRENT TIME = 085030
THE CPU TIMER = 79 SEC

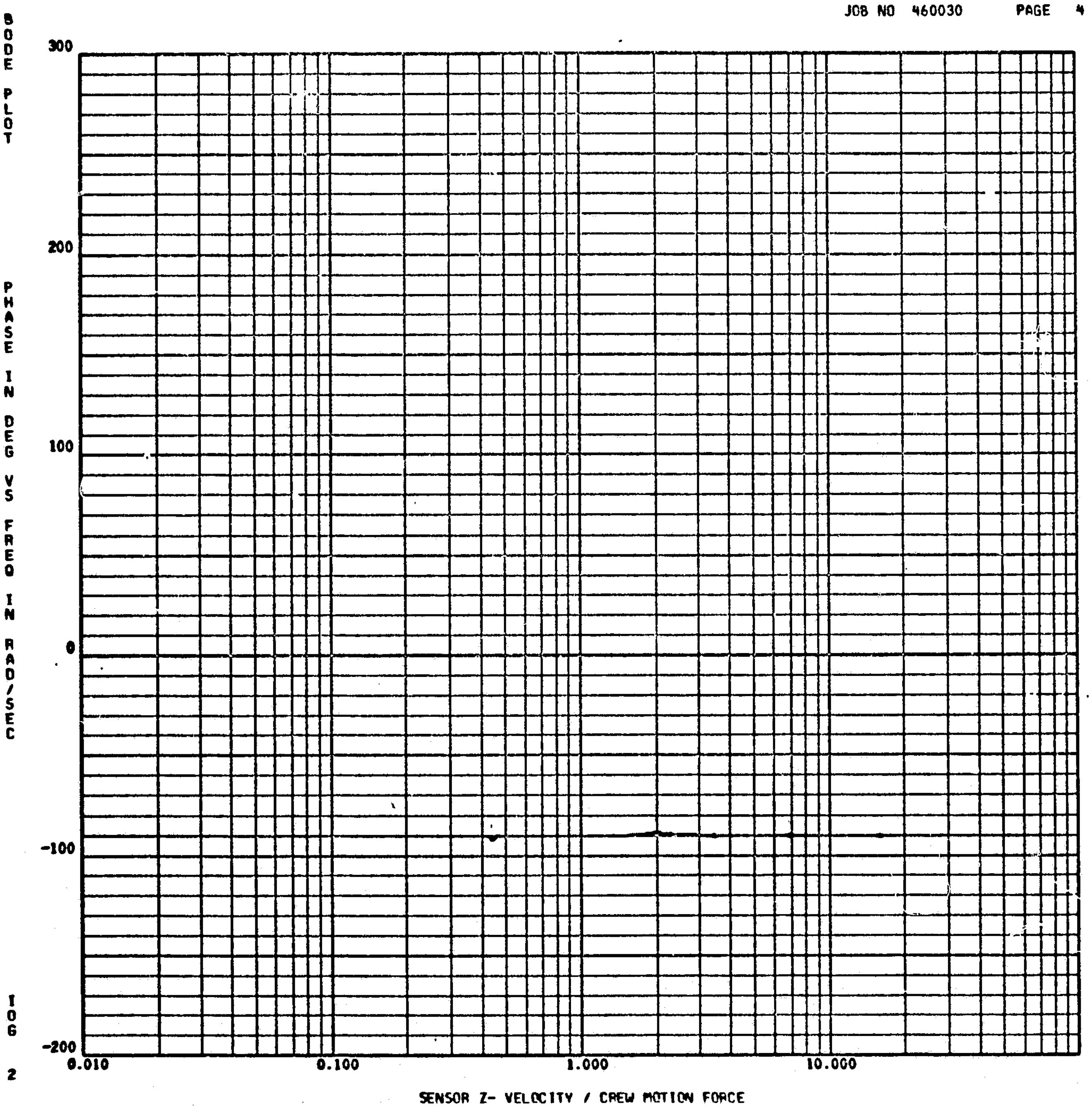
SENSOR Z- VELOCITY / CREW MOTION FORCE

FREQ/RAD/SEC	FREQ/HERTZ	REAL	IMAG	AMP	DECIBELS	RAD	DEG
.159779+002	.254282+001	.358317-009	-.275639-005	.275639-005	-111.193	4.7125	270.0074
.160092+002	.254794+001	.356854-009	-.275085-005	.275085-005	-111.211	4.7125	270.0074
.160415+002	.255308+001	.355327-009	-.274531-005	.274531-005	-111.228	4.7125	270.0074
.160739+002	.255823+001	.353884-009	-.273978-005	.273978-005	-111.246	4.7125	270.0074
.161064+002	.256341+001	.352363-009	-.273424-005	.273424-005	-111.263	4.7125	270.0074
.161719+002	.257383+001	.349443-009	-.272317-005	.272317-005	-111.298	4.7125	270.0073
.162379+002	.259434+001	.346485-009	-.271210-005	.271210-005	-111.334	4.7125	270.0073
.163211+002	.259759+001	.342862-009	-.269826-005	.269826-005	-111.378	4.7125	270.0072
.164053+002	.261098+001	.339176-009	-.268442-005	.268442-005	-111.423	4.7125	270.0072
.164703+002	.262451+001	.335639-009	-.267058-005	.267058-005	-111.468	4.7125	270.0072
.165762+002	.263818+001	.332022-009	-.265674-005	.265674-005	-111.513	4.7125	270.0071
.169289+002	.269431+001	.317897-009	-.260139-005	.260139-005	-111.696	4.7125	270.0070
.172969+002	.275288+001	.304110-009	-.254603-005	.254603-005	-111.883	4.7125	270.0068
.176812+002	.281406+001	.290649-009	-.249068-005	.249068-005	-112.074	4.7125	270.0067
.180831+002	.287801+001	.277504-009	-.243532-005	.243532-005	-112.269	4.7125	270.0065
.189442+002	.301506+001	.252153-009	-.232461-005	.232461-005	-112.673	4.7125	270.0062
.198914+002	.316581+001	.228149-009	-.221391-005	.221391-005	-113.097	4.7125	270.0059
.212175+002	.337687+001	.199926-009	-.207553-005	.207553-005	-113.657	4.7125	270.0055
.227330+002	.361807+001	.173645-009	-.193715-005	.193715-005	-114.257	4.7125	270.0051
.250000+002	.397887+001	.143149-009	-.176148-005	.176148-005	-115.082	4.7125	270.0046
.280000+002	.445634+001	.113770-009	-.157274-005	.157274-005	-116.067	4.7125	270.0041
.320000+002	.509296+001	.868852-010	-.137614-005	.137614-005	-117.227	4.7124	270.0036
.390000+002	.604789+001	.615316-010	-.115885-005	.115885-005	-118.719	4.7124	270.0030
.450000+002	.716197+001	.438703-010	-.978579-006	.978578-006	-120.188	4.7124	270.0025
.520000+002	.827606+001	.328640-010	-.846844-006	.846844-006	-121.444	4.7124	270.0022
.620000+002	.986761+001	.231382-010	-.710255-006	.710255-006	-122.972	4.7124	270.0018
.700000+002	.111408+002	.181620-010	-.629082-006	.629082-006	-124.026	4.7124	270.0016
.780000+002	.124141+002	.146296-010	-.564561-006	.564561-006	-124.966	4.7124	270.0015
.857143+002	.136419+002	.121256-010	-.513750-006	.513750-006	-125.785	4.7124	270.0013
.100000+003	.159155+002	.891364-011	-.440357-006	.440357-006	-127.124	4.7124	270.0011

END OF INPUT DATA HAS BEEN REACHED.

C-3


JOB NO 460030 PAGE 2
BODE PLOT
PHASE IN DEG VS FREQ IN RAD/SEC
LOG 2
300
200
100
0
-100
-200
0.010
0.100
1.000
10.000
PITCH RATE ERROR / CREW MOTION FORCE


JOB NO 460030 PAGE 4
BODE PLOT
PHASE IN DEG VS FREQ IN RAD/SEC
IOG 2
300
200
100
0
-100
-200
0.010
0.100
1.000
10.000
SENSOR Z- VELOCITY / CREW MOTION FORCE

APPENDIX -- USER PAKS AND DATA FOR EXAMPLE PROBLEMS

This appendix contains listings of the required user paks and data for the examples documented in Chapter VI.

```
      SUBROUTINE LTORQL (VTORQ)
      IMPLICIT DOUBLE PRECISION (A-H,O-Z)

      DIMENSION VTORQ(1)
      COMMON /KDSIZE/
     1                KR, KRT, KRX, KV1, KV2, KVX
      COMMON /VECTOR/
     E                Y   (250), YD (250)                              430
      COMMON /TIMESS/
     G                ST, DT, T, ET, TMST
C
      DATA I1ST/0/
C
      TLMT = 10.D0*DT
      IF (I1ST .NE. 0) GO TO 10
      IF (T .GT. TLMT) I1ST = 1
      CALL ZERO (VTORQ,1,KVX,1)
      VTORQ(34) = 1.D0
      VTORQ(35) = 1.D0
      RETURN
   10 CONTINUE
      CALL ZERO (VTORQ,1,KVX,1)
      RETURN
      END
```

```
      SUBROUTINE KHINGE (G)
      IMPLICIT DOUBLE PRECISION (A-H,O-Z)
      DIMENSION G(1)
      DIMENSION SK(6,3),DK(6,3),HNGT(6,3)
C
              COMMON /BHBSRD/                                            0 255
     *        BH(6,12, 9),BS(6,12,10),ROL(3,3, 5),DOL(3, 5)
              COMMON /CONPAR/
     *        CNTDTA(100)
              COMMON /MAXMUM/                                            0 415
     *        NBMAX,NHMAX,NSPMAX,NMWMAX,NMWBOD,NMDBOD,KMU,KY,KU          0 415
              COMMON /MOMENG/                                            0 3886
     *        P( 65),PMOM(30),HTOT(3),TOTL(3),ENGKE( 5),ENGPE( 5),
     *        TOTKE, TOTPE, TOTENG, AHTOT,ATOTL                          0 3888
              COMMON /SPECIF/                                            0 415
     *        BETAH(6, 5),BETAHD(6, 5),AMO(2, 5),RH(3,3,24),RS(3,3,20),
     *        DH(3,28),DS(3,20),IMO(3, 5),NMOW(5, 5),IFTSMW(10),
     *        NB,NH,NSPT,NOFMO,NDELTA,ITOPOL(2, 5),IRGFLX( 5),IHDATA(7, 5),
     *        LOCU(12),LENU(12),NU,NBETA,NLAM,NEQ
      COMMON /TQMTR/ TQ1,TQ2,TQ3,  PHIERR(3)
C
      EQUIVALENCE (CNTDTA(61),SK(1)), (CNTDTA(81),DK(1))
C
      TOTPE = 0.D0
C
      DO 10 L=1,NH
      DO 10 I=1,6
      HNGT(I,L) = -(SK(I,L)*BETAH(I,L) + DK(I,L)*BETAHD(I,L))
   10 TOTPE = TOTPE + 0.5D0*SK(I,L)*BETAH(I,L)**2
      HNGT(1,3) = HNGT(1,3) - TQ1
      HNGT(2,3) = HNGT(2,3) - TQ2
      HNGT(3,3) = HNGT(3,3) - TQ3
      TOTPE = TOTPE+.5D0*CNTDTA(55)*(BETAH(1,3)**2
     *  + (BETAH(2,3)-1.047197551D0)**2 + BETAH(3,3)**2)
C
C
      LEQ = IRGFLX(1) + 6
      DO 15 I=1,6
      F = HNGT(I,1)
      DO 16 J=1,LEQ
   16 G(J) = G(J) + F*BH(I,J,1)
   15 CONTINUE
C
      DO 20 L=2,NH
      NOBQ = ITOPOL(1,L)
      NOBP = ITOPOL(2,L)
      LQ = 2*L - 2
      LP = LQ + 1
      LOQ = LOCU(NOBQ) - 1
      LOP = LOCU(NOBP) - 1
      LEQ = IRGFLX(NOBQ) + 6
      LEP = IRGFLX(NOBP) + 6
      DO 20 I=1,6
      F = HNGT(I,L)
      DO 25 J=1,LEQ
      LOQJ = LOQ + J
   25 G(LOQJ) = G(LOQJ) + F*BH(I,J,LQ)
      DO 26 J=1,LEP
      LOPJ = LOP + J
   26 G(LOPJ) = G(LOPJ) + F*BH(I,J,LP)
   20 CONTINUE
C
```

```
RETURN

END
```

```
      SUBROUTINE CONTRL                                                 048   1
      IMPLICIT DOUBLE PRECISION (A-H,O-Z)
                                                                        0 4047
              COMMON /BHBSRD/                                           0 255
     *        BH(6,12, 9),BS(6,12,10),ROL(3,3, 5),DOL(3, 5)
              COMMON /CONPAR/
     *        CNTDTA(100)
      COMMON /LDSIZE/ NX,NY,NDLTA,NXSS,NBTQ,NJQ,NY2,ND2                 0 4048
              COMMON /SPECIF/                                           0 4049
     *        BETAH(6, 5),BETAHD(6, 5),AMO(2, 5),RH(3,3,24),RS(3,3,20),
     *        DH(3,28),DS(3,20),IMO(3, 5),NMOW(5, 5),IFTSMW(10),
     *        NB,NH,NSPT,NOFMO,NDELTA,ITOPOL(2, 5),IRGFLX( 5),IHDATA(7, 5),
     *        LOCU(12),LENU(12),NU,NBETA,NLAM,NEQ
              COMMON /VECTOR/                                           0 4054
     *        Y(250),YDT(250)                                          20 405
      COMMON /TQMTR/ TQ1,TQ2,TQ3,  PHIERR(3)
C
C
      DATA I1ST/ 0 /
      IF (I1ST .NE. 0) GO TO 10
      I1ST = 1
CCCCCCCCCC
CCCCCCCCCC
CCC   THE FOLLOWING STATEMENTS MUST ALWAYS BE IN CONTRL..
      NDLTA = NDELTA                                                    0 4057
      NXSS = 7
      NBTQ = 1
      IF (NDELTA .EQ. 0) RETURN                                         0 4060
CCCCCCCCCCC    CCC                                                      0 4061
CCCC----NOTE--THIS SUBROUTINE MUST ESTABLISH  NDLTA,NXSS AND NBTQ       0 4062
CCCCCCCCCCC                                                             0 4063
C                                                                       0 4064
      LDEL = LOCU(2*NB+2) - 1                                           0 4075
   10 CONTINUE
C
      PHIERR(1) = DATAN2(ROL(2,1,3),ROL(1,1,3))
      PHIERR(2) = -DASIN(ROL(3,1,3)) - 1.0471975D 0
      PHIERR(3) = DATAN2(ROL(3,2,3),ROL(3,3,3))
      ALFA = PHIERR(1)
      BETA = PHIERR(2) + 1.0471975D 0
      GAMA = PHIERR(3)
      TQ1 = CNTDTA(55)*PHIERR(1) + CNTDTA(56)*(DSIN(GAMA)/DCOS(BETA)
     *     *Y(14) + DCOS(GAMA)/DCOS(BETA)*Y(15))
      TQ2 = CNTDTA(55)*PHIERR(2) + CNTDTA(56)*(DCOS(GAMA)*Y(14)
     *   - DSIN(GAMA)*Y(15))
      TQ3 = CNTDTA(55)*PHIERR(3) + CNTDTA(56)*(Y(13) + DSIN(GAMA)*
     *     DSIN(BETA)/DCOS(BETA)*Y(14)  +
     *      DCOS(GAMA)*DSIN(BETA)/DCOS(BETA)*Y(15))
C
      YDT(LDEL+1) = TQ1
      YDT(LDEL+2) = TQ2
      YDT(LDEL+3) = TQ3
      YDT(LDEL+4) = PHIERR(1)
      YDT(LDEL+5) = PHIERR(2)
      YDT(LDEL+6) = PHIERR(3)
      RETURN                                                            0 4080
      END                                                               0 4081
                                                                            *
```

```
      SUBROUTINE EXTOR  (TEX,ISPN,NTEX)
      IMPLICIT DOUBLE PRECISION (A-H,O-Z)
      DIMENSION TEX(6,1), ISPN(1)
C
            COMMON /MAXMUM/
     *    NBMAX,NHMAX,NSPMAX,NMWMAX,NMWBOD,NMDBOD,KMU,KY,KU
            COMMON /SPECIF/
     *    BETAH(6, 5),BETAHD(6, 5),AMO(2, 5),RH(3,3,24),RS(3,3,20),
     *    DH(3,28),DS(3,20),IMO(3, 5),NMOW(5, 5),IFTSMW(10),
     *    NB,NH,NSPT,NOFMO,NDELTA,ITOPOL(2, 5),IRGFLX( 5),IHDATA(7, 5),
     *    LOCU(12),LENU(12),NU,NBETA,NLAM,NEQ
            COMMON /TIMESS/
     *    STARTT,DELTAT,T,ENDT,TMST
            COMMON /VECTOR/
     *    Y(250),YDT(250)
C
      DATA I1ST / 0 /
C
CCC ESTABLISH THE EXTERNAL FORCE/TORQUE (6-LONG VECTOR) AND NUMBER
CCC  THE CORRESPONDING SENSOR POINTS. ALSO ESTABLISH THE NUMBER OF
CCC  SIX-LONG VECTORS (NTEX).
C
      IF (I1ST .EQ. 1) GO TO 5
      I1ST = 1
      DO 10 I=1,6
      DO 10 J=1,NSPMAX
   10 TEX(I,J) = 0.D 0
C
    5 NTEX = 1
      ISPN(1) = 1
      TEX(6,1) = 0.D0
      IF (T .GT. 3.1D0) RETURN
      IF (T .LT. .8D0) TEX(6,1) = 125.D0*T
      IF (T .GT. 2.3D0) TEX(6,1) = -100.D0 + 125.D0*(T - 2.3D0)
C
      RETURN
      END
```

```
      SUBROUTINE SHAFTT (TSHFT)                                             050
      IMPLICIT DOUBLE PRECISION (A-H,O-Z)
      DIMENSION TSHFT(1)                                                  0 4124
C                                                                         0 4125
              COMMON /MAXMUM/                                             0 4126
     *      NBMAX,NHMAX,NSPMAX,NMWMAX,NMWBOD,NMDBOD,KMU,KY,KU            0 4127
              COMMON /SPECIF/                                             0 4128
     *      BETAH(6, 5),BETAHD(6, 5),AMO(2, 5),RH(3,3,24),RS(3,3,20),
     *      DH(3,28),DS(3,20),IMO(3, 5),NMOW(5, 5),IFTSMW(10),
     *      NB,NH,NSPT,NOFMO,NDELTA,ITOPOL(2, 5),IRGFLX( 5),IHDATA(7, 5),
     *      LOCU(12),LENU(12),NU,NBETA,NLAM,NEQ
              COMMON /VECTOR/                                             0 4133
     *      Y(250),YDT(250)                                              20 405
C                                                                         0 4135
      DATA I1ST / 0 /                                                     0 4136
C                                                                         0 4137
      IF (I1ST .EQ. 1) GO TO 10                                           0 4138
      I1ST = 1                                                            0 4139
      DO 5 I=1,NMWMAX                                                     0 4140
    5 TSHFT(I) = 0.D 0                                                    0 4141
C                                                                         0 4142
   10 CONTINUE
      RETURN
      END                                                                 0 4144
                                                                               *
```

```
      SUBROUTINE EQADD                                                  051
      IMPLICIT DOUBLE PRECISION (A-H,O-Z)
C
            COMMON /BHBSRD/                                             0 255
     *      BH(6,12, 9),BS(6,12,10),ROL(3,3, 5),DOL(3, 5)
            COMMON /DNAUX /                                             0 414
     *      NAUX                                                        0 414
            COMMON /MAXMUM/                                             0 415
     *      NBMAX,NHMAX,NSPMAX,NMWMAX,NMWBOD,NMDBOD,KMU,KY,KU           0 415
            COMMON /SPECIF/                                             0 415
     *      BETAH(6, 5),BETAHD(6, 5),AMO(2, 5),RH(3,3,24),RS(3,3,20),
     *      DH(3,28),DS(3,20),IMO(3, 5),NMOW(5, 5),IFTSMW(10),
     *      NB,NH,NSPT,NOFMO,NDELTA,ITOPOL(2, 5),IRGFLX( 5),IHDATA(7, 5),
     *      LOCU(12),LENU(12),NU,NBETA,NLAM,NEQ
            COMMON /VECTOR/                                             0 415
     *      Y(250),YDT(250)                                             20 405
      COMMON /TQMTR/ TQ1,TQ2,TQ3,  PHIERR(3)
      DATA I1ST/ 0/
C                                                                       0 415
      IF (I1ST .NE. 0) GO TO 5
      I1ST = 1
      NAUX = 8
      LDEL = LOCU(2*NB+2) - 1
    5 CONTINUE
C
      CALL MULT3  (BS(6,1,1),Y,SPV,1,6,1,6,1,1)
      YDT(NEQ+1) = Y(13)
      YDT(NEQ+2) = Y(14)
      YDT(NEQ+3) = Y(15)
      YDT(NEQ+4) = PHIERR(1)
      YDT(NEQ+5) = PHIERR(2)
      YDT(NEQ+6) = PHIERR(3)
      YDT(NEQ+7) = SPV
      YDT(NEQ+8) = Y(LDEL+1)
C
      RETURN                                                            0 417
      END                                                               0 417
```

```
IOG  1
SPACELAB - INSIDE OUT GIMBAL CONCEPT
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT
0000000000
    3    3    2    0    6
ITOPOL   2    3
    1    1    1    2    3
    2    1    0    1    2
0000000000
IRGFLX   1    3
0000000000
IFTSMW   1    2
    1    1    1    3
0000000000
IHDATA   7    3
    1    1   12   12   12
    2    1    0    0    0
    3    1    0    0    0
    4    1    0    0    0
    5    1    0    0    1
    6    1    0    0    1
    7    1    0    0    1
0000000000
BETAH    6    3
    2    3   1.047197551
0000000000
BETAHD   6    3
0000000000
TMDATA   1    3
    1    1     0.                 .020                 4.
0000000000
IPDATA   1    3
    1    1    5    1    0
0000000000
CNTDTA   1  100
    1   55   1865300.          83960.
    1   67    625.              625.               625.
    1   70     10000.         10000.             10000.
    1   87    63.43             63.43              63.43
    1   90   1014.889          1014.889          1014.889
0000000000
GRAVTY   1    4
0000000000
MASSO    1    4
    1    1   72497.               0.                 0.            0.
0000000000
INERO    1    6
    1    1  1001000.          7440000.           7650000.
0000000000
    2    1
   0.             0.        0.
    2.2           0.        0.
    1    1
    0.            0.         0.
   -15.            0.        0.
```

```
MASSM     1    4
   1      1   195.               0.          0.
0000000000
INERM     1    6
   1      1   50.               50.          50.
0000000000
   2      1

  0.          0.          0.



  0.          0.       -.375
   3      1
  0.          0.          0.
  0.          0.        .375
MASSI     1    4
   1      1   2380.              0.          0.          0.
0000000000
INERI     1    6
   1      1   2263.              2263.          2530.
0000000000
   3      1
  0.          0.          0.
  0.          0.       -1.85
   2      1
  0.          0.          0.
  0.          0.          0.
INSIDE OUT GIMBAL CONCEPT, NONLINEAR TIME RESPONSE TO CREW MOTION
   2
  16
   1   20   21   22   23   24   25   26   27   28   29   30   31   32   33
   1    2    3    4
TIME      EULERS 1  ORBITOR ANGULAR POSITION
   1    5    6    7
TIME      POSITION  ORBITOR X-Y-Z POSITION
   1    8    9   10
TIME      ANGLE 2   MOUNT/ORBITOR ANGULAR POSITION
   1   11   12   13
TIME      POSIT 2   MOUNT/ORBITOR X-Y-Z RELATIVE POSITION
   1   14   15   16
TIME      ANGLE 3   IOG GIMBAL ANGLES
0000000000
  15
   1   74   75   76   77   78   79   80   81   82  131  132  133  134  135
   1    2    3    4
TIME      TORQUE    GIMBAL TORQUES
   1    5    6    7
TIME      DELTAPHI  ATTITUDE ERRORS
   1    8    9   10
TIME      FORCE     GIMBAL X-Y-Z LAMBDAS
   1   11   12
TIME      MOMENTUM  ANGULAR/LINEAR MOMENTUM
   1   13   14   15
TIME      ENERGY    KINETIC, POTENTIAL AND TOTAL ENERGY
0000000000
STOP
```

```
      SUBROUTINE LTORQL (VTORQ)
      IMPLICIT DOUBLE PRECISION (A-H,O-Z)
C
      DIMENSION VTORQ(1)
      COMMON /KDSIZE/
     1                KR, KRT, KRX, KV1, KV2, KVX
      COMMON /VECTOR/
     E                Y   (250), YD (250)
      COMMON /TIMESS/
     G                ST, DT, T, ET, TMST
C
      DATA I1ST/0/
C
      TLMT = 10.D0*DT
      IF (I1ST .NE. 0) GO TO 10
      IF (T .GT. TLMT) I1ST = 1
      CALL ZERO (VTORQ,1,KVX,1)
      VTORQ(34) = 1.D0
      VTORQ(35) = 1.D0
      RETURN
   10 CONTINUE
      CALL ZERO (VTORQ,1,KVX,1)
      RETURN
      END
```

```
      SUBROUTINE KHINGE (G)
      IMPLICIT DOUBLE PRECISION (A-H,O-Z)
      DIMENSION G(1)
      DIMENSION SK(6,3),DK(6,3),HNGT(6,3)
C                                                                          0 255
              COMMON /BHBSRD/
     *     BH(6,12, 9),BS(6,12,10),ROL(3,3, 5),DOL(3, 5)
              COMMON /CONPAR/
     *     CNTDTA(100)                                                     0 415
              COMMON /MAXMUM/                                              0 415
     *     NBMAX,NHMAX,NSPMAX,NMWMAX,NMWBOD,NMDBOD,KMU,KY,KU               0 3886
              COMMON /MOMENG/
     *     P( 65),PMOM(30),HTOT(3),TOTL(3),ENGKE( 5),ENGPE( 5),            0 3888
     *     TOTKE, TOTPE, TOTENG, AHTOT,ATOTL                               0 415
              COMMON /SPECIF/
     *     BETAH(6, 5),BETAHD(6, 5),AMO(2, 5),RH(3,3,24),RS(3,3,20),
     *     DH(3,28),DS(3,20),IMO(3, 5),NMOW(5, 5),IFTSMW(10),
     *     NB,NH,NSPT,NOFMO,NDELTA,ITOPOL(2, 5),IRGFLX( 5),IHDATA(7, 5),
     *     LOCU(12),LENU(12),NU,NBETA,NLAM,NEQ
      COMMON /TQMTR/ TQ1,TQ2,TQ3,  PHIERR(3)
C
      EQUIVALENCE (CNTDTA(61),SK(1)), (CNTDTA(81),DK(1))
C
      TOTPE = 0.D0
C
      DO 10 L=1,NH
      DO 10 I=1,6
      HNGT(I,L) = -(SK(I,L)*BETAH(I,L) + DK(I,L)*BETAHD(I,L))
   10 TOTPE = TOTPE + 0.5D0*SK(I,L)*BETAH(I,L)**2
      HNGT(1,3) = HNGT(1,3) - TQ1
      HNGT(2,3) = HNGT(2,3) - TQ2
      HNGT(3,3) = HNGT(3,3) - TQ3
      TOTPE = TOTPE+.5D0*CNTDTA(55)*(BETAH(1,3)**2
     *  + (BETAH(2,3)-1.047197551D0)**2 + BETAH(3,3)**2)
C
C
      LEQ = IRGFLX(1) + 6
      DO 15 I=1,6
      F = HNGT(I,1)
      DO 16 J=1,LEQ
   16 G(J) = G(J) + F*BH(I,J,1)
   15 CONTINUE
C
      DO 20 L=2,NH
      NOBQ = ITOPOL(1,L)
      NOBP = ITOPOL(2,L)
      LQ = 2*L - 2
      LP = LQ + 1
      LOQ = LOCU(NOBQ) - 1
      LOP = LOCU(NOBP) - 1
      LEQ = IRGFLX(NOBQ) + 6
      LEP = IRGFLX(NOBP) + 6
      DO 20 I=1,6
      F = HNGT(I,L)
      DO 25 J=1,LEQ
      LOQJ = LOQ + J
   25 G(LOQJ) = G(LOQJ) + F*BH(I,J,LQ)
      DO 26 J=1,LEP
      LOPJ = LOP + J
   26 G(LOPJ) = G(LOPJ) + F*BH(I,J,LP)
   20 CONTINUE
C
```

```
RETURN

END
```

```
      SUBROUTINE CONTRL                                                 048   1
      IMPLICIT DOUBLE PRECISION (A-H,O-Z)
C                                                                       0 4047
            COMMON /BHBSRD/                                             0 255
     *      BH(6,12, 9),BS(6,12,10),ROL(3,3, 5),DOL(3, 5)
            COMMON /CONPAR/
     *      CNTDTA(100)
      COMMON /LDSIZE/ NX,NY,NDLTA,NXSS,NBTQ,NJQ,NY2,ND2                 0 4048
            COMMON /SPECIF/                                             0 4049
     *      BETAH(6, 5),BETAHD(6, 5),AMO(2, 5),RH(3,3,24),RS(3,3,20),
     *      DH(3,28),DS(3,20),IMO(3, 5),NMOW(5, 5),IFTSMW(10),
     *      NB,NH,NSPT,NOFMO,NDELTA,ITOPOL(2, 5),IRGFLX( 5),IHDATA(7, 5),
     *      LOCU(12),LENU(12),NU,NBETA,NLAM,NEQ
            COMMON /VECTOR/                                             0 4054
     *      Y(250),YDT(250)                                             20 405
      COMMON /TQMTR/ TQ1,TQ2,TQ3,  PHIERR(3)
C
C
      DATA I1ST/ 0 /
      IF (I1ST .NE. 0) GO TO 10
      I1ST = 1
CCCCCCCCCC
CCCCCCCCCC
CCC  THE FOLLOWING STATEMENTS MUST ALWAYS BE IN CONTRL..
      NDLTA = NDELTA                                                    0 4057
      NXSS = 7
      NBTQ = 1
      IF (NDELTA .EQ. 0) RETURN                                         0 4060
CCCCCCCCCCC    CCC                                                      0 4061
CCCC----NOTE--THIS SUBROUTINE MUST ESTABLISH  NDLTA,NXSS AND NBTQ       0 4062
CCCCCCCCCCC                                                             0 4063
C                                                                       0 4064
      LDEL = LOCU(2*NB+2) - 1                                           0 4075
   10 CONTINUE
C
      PHIERR(1) = DATAN2(ROL(2,1,3),ROL(1,1,3))
      PHIERR(2) = -DASIN(ROL(3,1,3)) - 1.0471975D 0
      PHIERR(3) = DATAN2(ROL(3,2,3),ROL(3,3,3))
      ALFA = PHIERR(1)
      BETA = PHIERR(2) + 1.0471975D 0
      GAMA = PHIERR(3)
      TQ1 = CNTDTA(55)*PHIERR(1) + CNTDTA(56)*(DSIN(GAMA)/DCOS(BETA)
     *      *Y(14) + DCOS(GAMA)/DCOS(BETA)*Y(15))
      TQ2 = CNTDTA(55)*PHIERR(2) + CNTDTA(56)*(DCOS(GAMA)*Y(14)
     *    - DSIN(GAMA)*Y(15))
      TQ3 = CNTDTA(55)*PHIERR(3) + CNTDTA(56)*(Y(13) + DSIN(GAMA)*
     *      DSIN(BETA)/DCOS(BETA)*Y(14)  +
     *       DCOS(GAMA)*DSIN(BETA)/DCOS(BETA)*Y(15))
C
      YDT(LDEL+1) = Y(14)
      YDT(LDEL+2) = Y(LDEL+1)
      RETURN                                                            0 4080
      END                                                               0 4081
```

```
      SUBROUTINE EXTOR  (TEX,ISPN,NTEX)                                 049
      IMPLICIT DOUBLE PRECISION (A-H,O-Z)
      DIMENSION TEX(6,1), ISPN(1)                                     0 4084
C                                                                     0 4085
              COMMON /MAXMUM/                                         0 4086
     *      NBMAX,NHMAX,NSPMAX,NMWMAX,NMWBOD,NMDBOD,KMU,KY,KU         0 4087
              COMMON /SPECIF/                                         0 4088
     *      BETAH(6, 5),BETAHD(6, 5),AMO(2, 5),RH(3,3,24),RS(3,3,20),
     *      DH(3,28),DS(3,20),IMO(3, 5),NMOW(5, 5),IFTSMW(10),
     *      NB,NH,NSPT,NOFMO,NDELTA,ITOPOL(2, 5),IRGFLX( 5),IHDATA(7, 5),
     *      LOCU(12),LENU(12),NU,NBETA,NLAM,NEQ
              COMMON /TIMESS/
     *      STARTT,DELTAT,T,ENDT,TMST
              COMMON /VECTOR/                                         0 4093
     *      Y(250),YDT(250)                                          20 405
C                                                                     0 4095
      DATA I1ST / 0 /                                                 0 4096
C                                                                     0 4097
CCC ESTABLISH THE EXTERNAL FORCE/TORQUE (6-LONG VECTOR) AND NUMBER    0 4098
CCC  THE CORRESPONDING SENSOR POINTS. ALSO ESTABLISH THE NUMBER OF    0 4099
CCC  SIX-LONG VECTORS (NTEX).                                         0 4100
C                                                                     0 4101
      IF (I1ST .EQ. 1) GO TO 5                                        0 4102
      I1ST = 1                                                        0 4103
      DO 10 I=1,6                                                     0 4104
      DO 10 J=1,NSPMAX                                                0 4105
   10 TEX(I,J) = 0.D 0                                                0 4106
C                                                                     0 4107
    5 NTEX = 1
      ISPN(1) = 1
      LDEL = LOCU(2*NB+2)- 1
      TEX(6,1) = Y(LDEL+2)
C                                                                     0 4109
      RETURN                                                          0 4120
      END                                                             0 4121
                                                                           *
```

```
      SUBROUTINE SHAFTT (TSHFT)
      IMPLICIT DOUBLE PRECISION (A-H,O-Z)
      DIMENSION TSHFT(1)
C
            COMMON /MAXMUM/
     *      NBMAX,NHMAX,NSPMAX,NMWMAX,NMWBOD,NMDBOD,KMU,KY,KU
            COMMON /SPECIF/
     *      BETAH(6, 5),BETAHD(6, 5),AMO(2, 5),RH(3,3,24),RS(3,3,20),
     *      DH(3,28),DS(3,20),IMO(3, 5),NMOW(5, 5),IFTSMW(10),
     *      NB,NH,NSPT,NOFMO,NDELTA,ITOPOL(2, 5),IRGFLX( 5),IHDATA(7, 5),
     *      LOCU(12),LENU(12),NU,NBETA,NLAM,NEQ
            COMMON /VECTOR/
     *      Y(250),YDT(250)
C
      DATA I1ST / 0 /
C
      IF (I1ST .EQ. 1) GO TO 10
      I1ST = 1
      DO 5 I=1,NMWMAX
    5 TSHFT(I) = 0.D 0
C
   10 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE EQADD                                                    051  1
      IMPLICIT DOUBLE PRECISION (A-H,O-Z)
C
             COMMON /BHBSRD/                                              0 255
     *    BH(6,12, 9),BS(6,12,10),ROL(3,3, 5),DOL(3, 5)
             COMMON /DNAUX /                                              0 414
     *    NAUX                                                            0 414
             COMMON /MAXMUM/                                              0 415
     *    NBMAX,NHMAX,NSPMAX,NMWMAX,NMWBOD,NMDBOD,KMU,KY,KU               0 415
             COMMON /SPECIF/                                              0 415
     *    BETAH(6, 5),BETAHD(6, 5),AMO(2, 5),RH(3,3,24),RS(3,3,20),
     *    DH(3,28),DS(3,20),IMO(3, 5),NMOW(5, 5),IFTSMW(10),
     *    NB,NH,NSPT,NOFMO,NDELTA,ITOPOL(2, 5),IRGFLX( 5),IHDATA(7, 5),
     *    LOCU(12),LENU(12),NU,NBETA,NLAM,NEQ
             COMMON /VECTOR/                                              0 415
     *    Y(250),YDT(250)                                                20 405
      COMMON /TQMTR/ TQ1,TQ2,TQ3,  PHIERR(3)
      DATA I1ST/ 0/
C                                                                         0 415
      IF (I1ST .NE. 0) GO TO 5
      I1ST = 1
      NAUX = 8
      LDEL = LOCU(2*NB+2) - 1
    5 CONTINUE
C
      CALL MULT3  (BS(6,1,1),Y,SPV,1,6,1,6,1,1)
      YDT(NEQ+1) = Y(13)
      YDT(NEQ+2) = Y(14)
      YDT(NEQ+3) = Y(15)
      YDT(NEQ+4) = PHIERR(1)
      YDT(NEQ+5) = PHIERR(2)
      YDT(NEQ+6) = PHIERR(3)
      YDT(NEQ+7) = SPV
      YDT(NEQ+8) = Y(LDEL+2)
C
      RETURN                                                              0 417
      END                                                                 0 417
                                                                               *
```

```
IOG  2
SPACELAB - INSIDE OUT GIMBAL CONCEPT   (FREQUENCY DOMAIN)
SHUTTLE(ORBITOR)/SOFTMOUNT/IOG/INSTRUMENT
0000000000
   3    3    2    0    2
ITOPOL  2    3
   1    1    1    2    3
   2    1    0    1    2
0000000000
IRGFLX  1    3
0000000000
IFTSMW  1    2
   1    1    1    3
0000000000
IHDATA  7    3
   1    1   12   12   12
   2    1    0    0    0
   3    1    0    0    0
   4    1    0    0    0
   5    1    0    0    1
   6    1    0    0    1
   7    1    0    0    1
0000000000
BETAH   6    3
   2    3   1.0471975
0000000000
BETAHD  6    3
0000000000
TMDATA  1    3
   1    1    0.                 .015              .5
0000000000
IPDATA  1    3
   1    1    1    0    1
0000000000
CNTDTA  1  100
   1   55   1865300.         83960.
   1   67   625.              625.              625.
   1   70    10000.         10000.            10000.
   1   87   63.43             63.43             63.43
   1   90   1014.889         1014.889          1014.889
0000000000
GRAVTY  1    4
0000000000
MASSO   1    4
   1    1   72497.             0.               0.           0.
0000000000
INERO   1    6
   1    1  1001000.          7440000.          7650000.
0000000000
   2    1
  0.          0.       0.
   2.2        0.       0.
   1    1
   0.         0.        0.
  -15.         0.       0.
```

```
MASSM     1    4
    1     1   195.                    0.              0.                  0.
0000000000
INERM     1    6
    1     1    50.                 50.               50.
0000000000
    2     1

   0.          0.          0.


   0.          0.      -.375
    3     1
   0.         0.           0.
   0.         0.        .375
MASSI     1    4
    1     1   2380.                 0.                 0.                 0.
0000000000
INERI     1    6
    1     1   2263.                2263.              2530.
0000000000
    3     1
    0.           0.        0.
    0.           0.     -1.85
    2     1
   0.         0.          0.
   0.         0.          0.
FREQ
LRY       9    7
    1     1    1    1    1    1    1    1    1
    2     1    1    1    1    1    1    1    1
    3     1    1    2    3    4    5    6    7
    4     1    1    1    1    1    1    1    1
0000000000
IRY       3    7
    1     1   -4   -4   -4   -4   -4   -4   -4
    2     1   -4   -4   -4   -4   -4   -4   -4
    3     1   -6   -6   -6   -6   -6   -6   -6
0000000000
  YAW RATE ERROR / CREW MOTION FORCE
BONN
 0.01       100.0      -20.0      20.0         .001       10.0
PITCH RATE ERROR / CREW MOTION FORCE
BONN
 0.01       100.0      -20.0      20.0         .001       10.0
 ROLL RATE ERROR / CREW MOTION FORCE
BONN
 0.01       100.0      -20.0      20.0         .001       10.0
  YAW ATTITUDE ERROR / CREW MOTION FORCE
BONN
 0.01       100.0      -20.0      20.0         .001       10.0
```

```
PITCH ATTITUDE ERROR / CREW MOTION FORCE
BONN
 0.01       100.0      -20.0      20.0       .001       10.0
 ROLL ATTITUDE ERROR / CREW MOTION FORCE
BONN
 0.01       100.0      -20.0      20.0       .001       10.0
SENSOR Z- VELOCITY / CREW MOTION FORCE
BONN
 0.01       100.0      -20.0      20.0       .001       10.0
STOP
```